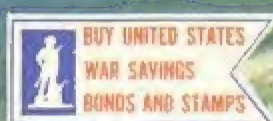


Uncle Sam's Warbirds

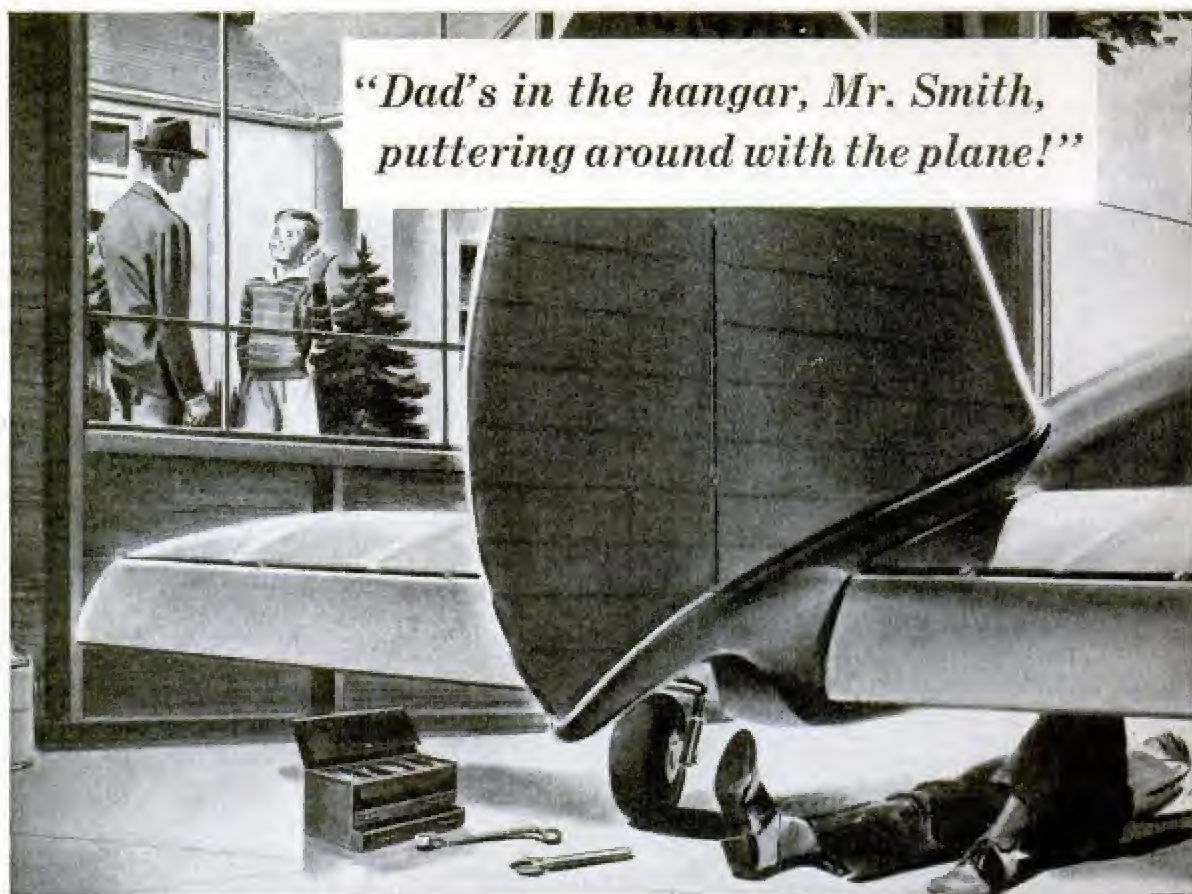
POPULAR MECHANICS MAGAZINE

WRITTEN

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SEE PAGE 6



AMERICANS love to putter with things mechanical. It's this restless, inquisitive trait in our national character that has set the pace for the world of the present . . . that will build the new America.

Because we can already see it on the horizon. We can see it in the skill and ingenuity of the men now working night and day in the arsenals of democracy. These are the hearts and hands that will shape it.

These men, who are now making the world's best combat and training planes, will be making family planes for you and me and the folks who live next door. These men, now building bombing planes that are the envy of a warring world, will be making luxury transports and super-cargo carriers of the air.

How far off is the birthday of this new America? Not very . . . because our hearths and furnaces and production lines are already forging Victory.

You'd feel as confident as we if you were in

B. F. Goodrich plants now . . . if you had seen what our Aeronautical Division has developed in the short span of a single man's life. Giant tires that bring a Flying Fortress to rest as gently as a tiny sparrow. Brakes that halt a ship that flies faster than sound can travel. De-Icers that defy the elements.

Today, this B. F. Goodrich equipment goes to the air forces of the United Nations. It flies with planes that make history over Wake Island, Burma, Tokio, and the Sahara. But *tomorrow* it's going to help make a different kind of history. *It's going to help America create the new world!* The B. F. Goodrich Company, Aeronautical Division, Akron, O.



Skyway or Highway

B.F. Goodrich

FIRST IN RUBBER

HERE ARE SOME
AMERICAN PLANES
THAT ARE SUPPLIED
WITH B. F. GOODRICH
EQUIPMENT



→ CULVER PIPER ERCOUE



A United States Marine dodges swiftly across the battle-scarred slope, takes position behind a shattered wall that commands the enemy gun emplacement across the tiny valley.

A shell explodes in a shower of dirt, two hundred yards away from the enemy gun.

The Marine speaks quietly into the tiny microphone in his hand. "AK9 to BJ. Left four zero. Two hundred short." Miles away, an American artillery officer issues swift commands to his gun crew.

"Mission accomplished!"



Another shell-burst, this time in front of the target. "AK9 to BJ," says the leatherneck. "Left one zero. One hundred short."



The "walkie-talkie" is only one of many Westinghouse electrical products for America's ground forces. In tanks and combat cars—at artillery and anti-aircraft posts and communications centers—in the field and behind the lines, more than a hundred kinds of Westinghouse electrical equipment are in use. Even in base and field hospitals, Westinghouse X-Ray machines and ultra-violet Sterilamps* are helping daily to save the lives of wounded men.

For our ground forces, as well as for our naval and air forces, every ounce of Westinghouse "know-how" is on the job—to provide more and more of the deadliest fighting weapons that skill and ingenuity and hard work can produce.

And then, suddenly, a terrific, ground-shaking explosion across the valley . . . the enemy gun emplacement disappears in a black, billowing geyser of rocks and smoke and rubble. The Marine puts the microphone to his lips.

"AK9 to BJ—Mission accomplished! AK9 to BJ—Mission accomplished!"

Mission accomplished—a direct hit! *Because the miracle of electricity has been put to work again*—in the rugged, compact radio transmitter and receiver that rides comfortably across the devil dog's back. "Walkie-talkie," the Marines call it—a light, completely self-contained unit that allows constant two-way communication with unhampered freedom of movement. On scores of vital assignments, from spotting artillery fire to co-ordinating the movement of advance patrols, the "walkie-talkie" is helping to make American Marines the deadly fighting team that they are.



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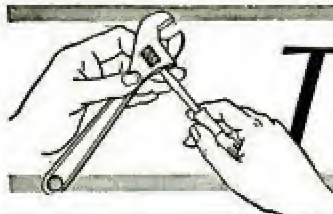
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Illustrations by Howard Chandler Christy



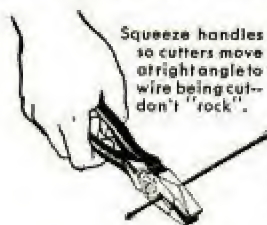
TOOL NOTES

Maintenance
and Repair
Suggestions to
Prolong Tool Life

No. 4 THE USE AND CARE OF CRESCENT CUTTING PLIERS...

Crescent Cutting Pliers are made in several types to designs which are now pretty well standardized. Since the service for which these tools are intended varies, it is necessary to classify the different types somewhat in discussing their care.

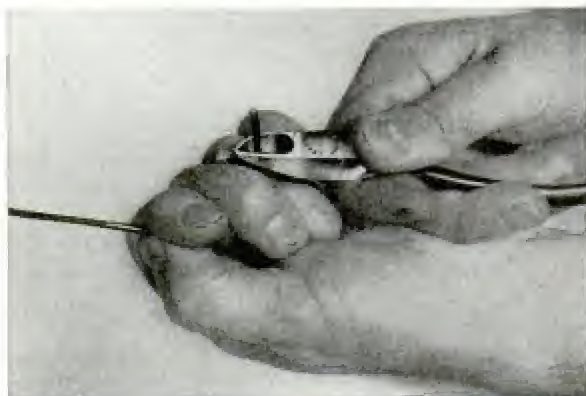
"SIDE CUTTERS". This term is applied to the widely-used lineman's or electrician's type which combines a *gripping* and *cutting* tool. Design is such that the blades of the side-cutters meet, yet the gripping jaws are still open a few thousandths. Such design insures clean cutting of fine silk wire insulation. Chief precaution in using this type is to avoid any "rocking" or "prying" action in cutting thru tough material (see sketch). Don't, of course, hammer the handles or



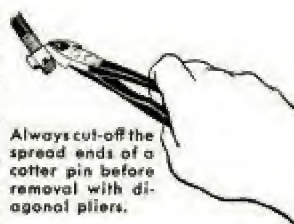
squeeze them in a vise—use a larger and heavier plier. All pliers are *hand* tools and are designed to withstand leverages resulting from the grip of the human hand. Don't expect a "side-cutter" to do the work of a "bolt-clipper"!

"LIGHT DIAGONALS". These are strictly a "cutting" plier and are used extensively by telephone and radio men, who work with the lighter gauges of insulated wire. Designed for cutting, skinning and "cleaning", they are not intended for heavy work. Large illustration above shows one of these tools being used to "skin" telephone wire.

"HEAVY DIAGONALS". Basically the same type as "Light Diagonals" but of heavier construction and therefore may be used in a manner that would constitute abuse of the lighter type. When Heavy Diagonals are used for removing cotter pins, the "spread



ends of the pin must first be cut off. Prying the pin out without first doing this may damage the tool, and is definitely poor practice. After cutting the spread ends, the head of the cotter pin is then gripped and lifted out, as shown in sketch.



"END CUTTERS". Also called "nippers", characteristically have a generous leverage ratio and therefore are powerful cutters. Their advantage is ability to cut close to flat surfaces. The larger and heavier patterns afford a versatile tool capable of withstanding considerable prying action. For example, a common and permissible use is withdrawing "headless" nails and pulling *finish* and *casing* nails thru trim lumber. Carpenters use this method frequently in remodeling work when "cleaning-up" old casings.



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Popular Mechanics Magazine

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H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

January, 1943

Vol. 79, No. 1

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Here Come the "Cats!"

BACK in '39 the Catalinas were declared obsolete. After that they began making history. It was one of these flying boats that spotted and trailed the Bismarck for 27 hours. Navy Patrol Wing 10 was in the Philippines with 42 "Cats" when the Japs hit; three months later two of the original group reached Australia. A Catalina knocked four Germans out of Gibraltar's sky. Another, crossing the Atlantic, reached England with two ailerons, a wing tip and radio missing. One of the epics of the war is the story of the "Cats," scheduled for the February issue.

Jungle Mechanics

TO KILL the matriarch of an elephant herd you hang a poisoned spear, heavily weighted with rocks, to a weak branch of a tree whose leaves are a particular delicacy to elephants. Then you wait. The jungle folk have their own system of mechanics, of which Attilio Gatti, noted explorer, tells in a fascinating two-part story beginning next month.

Next Month

YOU thought glass was that fragile stuff that splintered into a thousand pieces when the kid next door slammed his home run through your parlor window. It is; but it is also the stuff that makes life jackets float, it is the two-ton eye of the battleship North Carolina, it is the thread with which the surgeon sews your wound. In one dazzling experiment a scientist pours molten metal in a glass beaker set on a cake of ice. The glass takes it without complaint. Read the February feature, "Glass Pinch-Hits for the Whole Team."

Tough Guys

SOME of the boys in our toughening army, navy and marine force are shocked the first time their tough instructors tell them to "bust 'em in the eardrums! Break their spines!" But they are learning that it's no Sunday School field meet they're training for. It's war, and they must be ready to face, alone, a desperate and tricky foe. How they're preparing is told in an article next month: "Tough Guys of the Armed Forces."

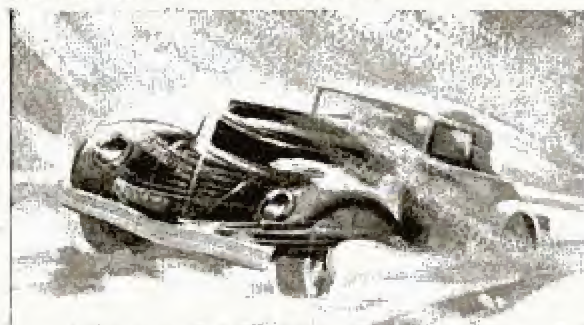
Riding the Fast Mail

MERE passenger trains slink in to the nearest sidings when Santa Fe No. 7 comes highballing down the track. It's the Fast Mail, a 48-hour train from Chicago to Los Angeles, and it stops only when the engine is tired or hungry. If you'd like a fast ride, get aboard—but don't ask any favors. This train works for Uncle Sam. Its story appears in February.

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**Say you saw it in
POPULAR MECHANICS**

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Can this happen to YOU?

It was the President talking—telling George that while he would like to give him the job—to promote him to an executive position, it was impossible to do so.

This was a bitter blow to George—he had known for some time there would be a vacancy in his department—the department manager was moving up—a new department head would be appointed. By seniority George was entitled to the job, had been counting on it.

It would mean more money—those unpaid bills would be taken care of—the children would have more advantages—there would be travel, recreation, social activities.

George had been a fine, loyal employee for twelve years—doing his assigned tasks well—hoping by faithful service to win some day an executive position with his company.

Now all of these hopes were being swept away—as in a dream he heard his chief continue—“You see, George, in these days it is ability to produce that counts. You’re not ready to take on the bigger job—you have made no preparations which would enable you to fill it properly. The man who is going to get that job is Martin. He has been with us only four years, but during that time he has not only been studying the relationship of his department to

the business as a whole, but he has been studying and preparing himself at home.”

Poor George—no one to blame but himself. Business is full of “Georges”—men who do not realize the importance of preparing definitely for promotion. They forget that long experience on one job does not necessarily prepare them for the job above. And almost never do they reach the executive job and the bigger money.

Fortunately, there is a way—simple, practical, thoroughly proved by thousands—for the “Georges” to make sure of promotion. Modern home study—the LaSalle way—gives them rather quickly the knowledge and ability to handle the job ahead. It does not interfere with their present job—instead it helps. It is moderate in cost and intensely interesting.

In fairness to yourself—

If you are one of the men in business doing routine work—going along in a low pay job, there is one thing, in fairness to yourself, you should do right away—and that is—**FILL IN AND MAIL THE COUPON BELOW AT ONCE.** It can be the turning point in your business career toward the bigger rewards business is willing to pay to the man who is trained. Our **FREE** booklet “TEN YEARS PROMOTION IN ONE” is most inspiring. Don’t let a postage stamp and one minute stand between you and full details regarding our training and opportunities to which such training leads.

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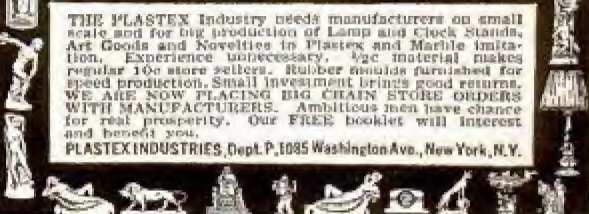
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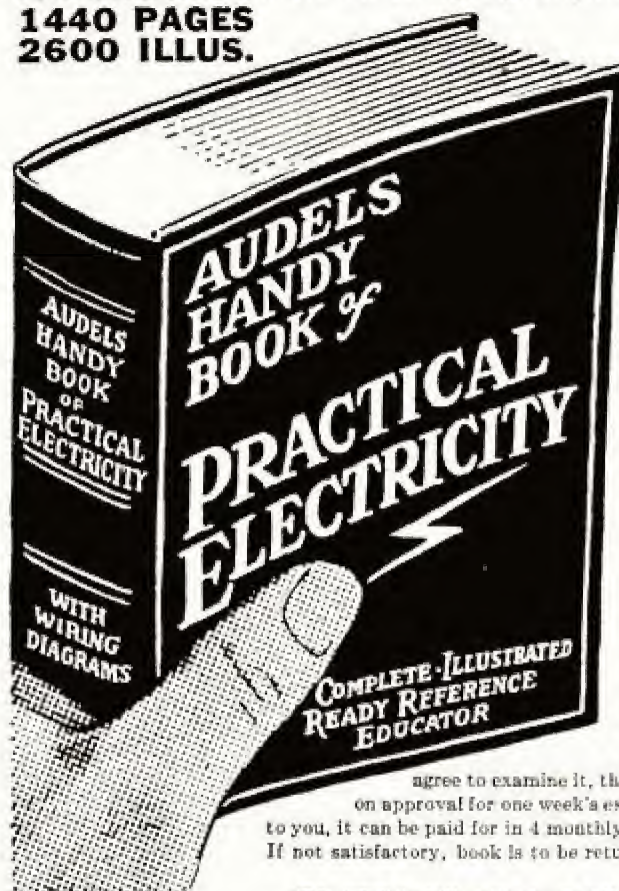
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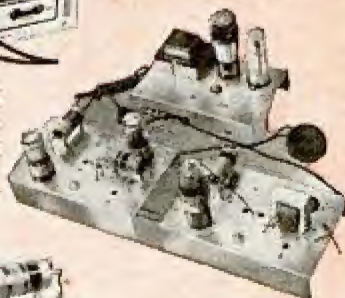
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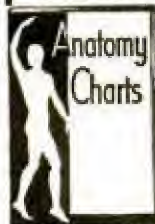
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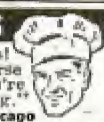
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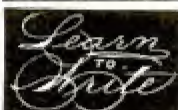
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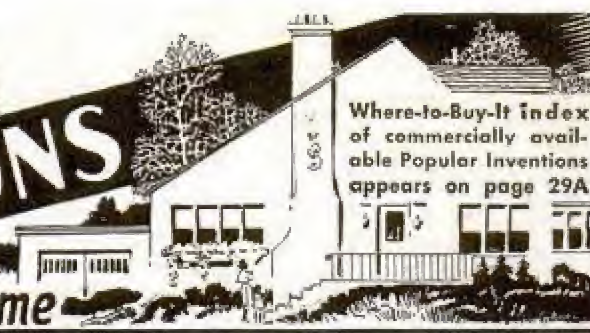
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Holes Punched in Milk Carton Convert It to Salt Shaker *m 701*



Garden Hose Dolly Holds Nozzle At Constant Sprinkling Angle *m 942*

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(More Popular Inventions on page 29A)

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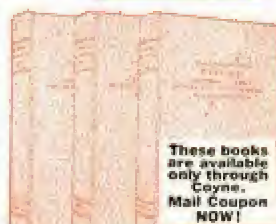
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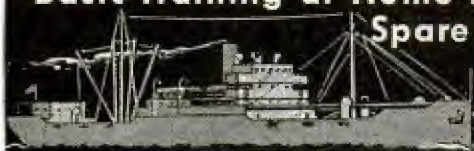
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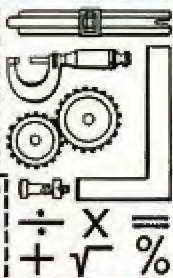
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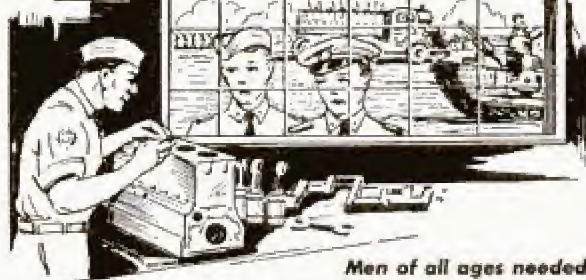
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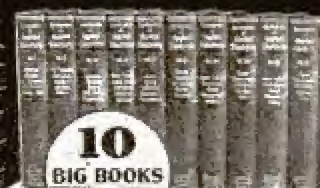
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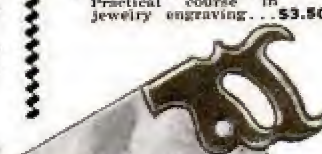
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(Continued from page 22A)

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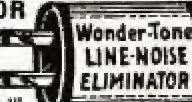
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DON'T Be a job hunter—Start your own business on your capital. No hard times; no layoffs; always your own boss. Hundreds average \$3,000 to \$5,000 annual sales year after year. We supply stocks, equipment on credit, 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world wide industry. Write Rawleigh Co., Dept. A-U-PPMB, Freeport, Ill.

MAIL Order beginners "Business Development Plan." "Profitable Mail Selling Ideas." "Profitable Mail-ad Ideas." Show "how to make mail order business pay." All three postpaid, quarter. Mail Industries Service, Glasgow, Montana.

START Home business making statuary, plaques, art goods, novelties, souvenirs, concrete pottery, garden furniture, artificial marble flooring, liquid marble. Make your own flexible molds. Amazing profits. Valuable folder free. Creative Publishers. (PM1) Glencoe, Illinois.

FOR An extremely profitable lifetime business. operate a collection agency—credit bureau. Many make \$4,000 yearly, up. Write Cole Associates, Syracuse, N. Y.

FREE—200 Clever mailorder, homework, local business offers—all snappy money-makers. Lewis Co., 828-M Carpenter, Oak Park, Illinois.

THE Lord's coming! Get 30 reliable proofs free. Scheall, 263X, Duluth, Minnesota.

AMAZINGLY Successful mailorder plan. Work at home. Pays well. Literature and valuable plan 10c. Leonard Publishers, 265 West 93rd Street, New York, N. Y.

MILLION Articles. Buy wholesale. Valuable directory 10c. Ideal Service, D-1, Park Ridge, Ill.

START Lettershop at home. White collar profession. Professional Products Company, Madisonville, Cincinnati.

UNPAINTED Wall plaques 5c each. Request literature. Omman, 643 Broadway, St. Paul, Minnesota.

START Big paying mail order business at home. Particulars free! General Sales, 1241 Broadway, Suite 204-A, New York.

EARN Up to \$500.00 back yard gardening. working plan 25c. Lightning Speed, Streator, Illinois.

FORTIFY The future. "Permit to Publish"—offers profitable projects—all types. Write, Maupin, LaFayette, Indiana.

SAVO-GAS. Biggest moneymaker yet. Quarter brings sample. Marshall, Box 151, Beeville, Texas.

MAKE Your own Flexible Molds. Statuary, Art Goods, Novelties, Artificial Marble Flooring, Liquid Marble. Literature free. Kemico, 113-M, Park Ridge, Ill.

VALUABLE Mail order information. Merchandise. Magazine and particulars 25 cents. The Light Bearer Publishing Co., 126 Lexington Avenue, New York.

SELL By mail! Literature free! Ellico, 1554 Sierra-Ln., Stockton, Calif.

AMBITIOUS People only! The time is ripe. Operate mail order business at home. Particulars free. Hodges, 321 East 41st, Chicago, Ill.

GREATEST Legitimate mail order plan —\$1.00. Stamp brings information. Fralon, 249 Michigan Street, Rochester, N. Y.

MECHANICALLY Inclined men—Own and operate general appliance repair shop. Complete, illustrated course shows you how. Welding, refrigeration, motor repair, how to get business, etc., all phases covered. Free literature. Christy Supply, Dept. 124, 2835 N. Central Ave., Chicago.

WILL Buy or finance mail order business or correspondence school course. Give complete details. Art White, 1107 Times Star Bldg., Cincinnati.

AGENTS—To mail our literature. Good profits. Home business. Maywood, 1133 Broadway, New York.

95c PROFIT From every \$1. Less than \$1 starts business. Adamec, 91-A Wall Street, New York.

"MONEY Making Business Starters." \$1.00 book value of wonderful opportunities, now 25c. C. A. Fetzer, Bellefonte, Penna.

MEN! Defense plant addresses all over U. S. 25c. Schwartz, 491 Cleveland, Brooklyn, N. Y.

FULL Or sparetime propositions galore in "Money Making Business Starters." A \$1.00 book you can have for 25c prepaid. Order today. I. W. Meeks Pub. Co., Box 792, Weed, Calif.

\$50.00, \$100.00 WEEKLY Using sawdust. Stamp please. Clement, 80R Gorsline St., Rochester, N. Y.

SELL By mail. Become a co-publisher. Make all the profits. Success does not come over night, but you must know the fundamental principles to succeed. Particulars free. Harry Dean, 1828 Ave "L," Galveston, Texas.

SCIENTIFIC Simplified manufacturing processes. Trade secrets. Profits to 1,500%. Thermosm, Peoria, Ill.

5 MOST Read mail order magazines 20c. Armand Cartier, 695A North, Pittsfield, Mass.

DOLLARS Daily! Start home; mail-order; businesses. Duffy, Covington, Ky.

2c DAILY Operates New York office under your own name. Co-operative Offices, 126 Lexington Avenue, New York.

MAKE Artificial marble, glazed tiles, plaques, figurines, sanitary flooring, pottery, novelties. Brilliantly colorful samples free. (Also—Selfhelp arts, wealth culture, psychology, hypnotism.) Payn, 945 Grande Vista (Room 101), Los Angeles, Calif.

MAKE Money collecting money. Good income; quick results. National Collectors, Newark, Ohio.

LIQUID Marble—Colorful, glazed! Mold, brush, spray! Composition floors, rubber-lastic molds. Particulars free. Marbleizing Service, Edwardsville, Illinois.

FREE Booklet. How to manufacture many products. Western, 201 Climax Bldg., Cleveland, Ohio.

BRUSH Plating outfits connect to a battery, no tanks necessary. Almost as simple as painting. Your opportunity to make good income plating autoparts, bathroom fixtures, reflectors, mirrors. Get free proof and particulars that put you in a paying business of your own. Gunmetal Co., Ave. H, Decatur, Illinois.

COLOR Cement with chemicals. Make artistic cement garden ornaments Hollywood style. Sample 10c. Hollywood Cementcraft, 8627 Wonderland, Hollywood, Calif.

STATUARY: Make all kinds. Simple process. Make and install artificial stone flooring in color. Liquid marble. Other money-makers. Write promptly. Literature free. Compo-Tex, Box 786, St. Louis, Mo.

PLASTEX Industries offers industrious men an opportunity to start a business of their own, manufacturing art goods, novelties, souvenirs, etc., in Plastex and marble imitation. 5c material makes \$1 articles. Rubber moulds furnished for speed production. Small investment brings good returns. We are now placing big chain store orders with manufacturers. Write for interesting booklet mailed free. Plastex Industries, Dept. A, 1085 Washington Ave., New York.

WEBER Typewriter Mechanics School. Simplified homestudy-repairing increasing. Canton, Ohio.

HOW And where to obtain capital. Fully explained, particulars free. Star Service, Wapakoneta, Ohio.

POPCORN And potato chip machines. We help start men and women in business. Long-Eakins, 1960 High, Springfield, Ohio.

CHARTERS: Delaware; best, cheapest; free forms. Colonial Charter Co., Wilmington, Del.

127 WAYS To make money, in home or office, business of your own. Full particulars free. Elite Co., 214 Grand St., New York.

START Home business making concrete garden furniture, pottery, bird bath, flower boxes. Amazing profits. Illustrated instruction book 25c. Popular Mechanics, 200 E. Ontario, Chicago.

MONEYMAKING OPPORTUNITIES

LICK After-war layoffs! Establish sparetime home business—added income now; future security. Free details scores successful moneymaking plans. Co-Operative Service, 734 Ashland, Buffalo, N. Y.

MAN, You'll like silvering mirrors, reflectors! Making chipped glass nameplates, signs, mottoes. Outfit prices. Sprinkle, Plater, M287, Marion, Indiana.

MAILORDER Income. Boundless opportunities. Particulars free. MacMillen, 273B, Lancaster, Ohio.

MAKE Extra money in your home. Very little capital required. Details free. Lumco, Kimball, Nebr.

MOLDMAKING—Plaster Casting. Complete formulas—fully illustrated. 25c. Ideal Service, RM-1, Park Ridge, Ill.

EARN Money evenings, copying and duplicating comic cartoons for advertisers. Adservice, Argyle, Wisconsin.

SAVO-GAS. Biggest moneymaker yet. Quarter brings sample. Marshall, Box 151, Beeville, Texas.

DETECTIVES Earn big money. Experience unnecessary. Particulars free. Waggoner, K-2640 Broadway, N. Y.

CHIPPING Glass signs. Folder free. Beveridge, 160-22 P Locust, Jamaica, N. Y.

PROFITABLE Homework. Fascinating sample 10c. Woodcraft, 1320 Lindsay Street, Gainesville, Texas.

EARN Extra money reporting news for business magazines. Anyone can learn. Instructions, \$1 bill. Free circular. Wimmer Bureau, 149 Bellaire, Louisville, Ky.

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MAKE \$6,000 An acre. Source of instructions 25c. Raymond Tilbury, Guthrie, Okla.

YOUR Name printed in 10,000 "Big Mail" directories 25c. Checking copies sent. Arlesse's, 15891 Log Cabin, Detroit, Michigan.

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MONEYMAKING Ideas—Latest books—Bargain catalog free. Popular Mechanics, 633 St. Clair, Chicago.

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COLCHICINE—Plant evolution chemical, soilless, hormones. Booklet 10c. Questok, Wellesley, Mass.

MAKE A gallon of sun tan oil for 40c. Same as life guards use. Recipe 35c. McClain, 376 W. G. Blvd, Detroit, Mich.

"LUMINOUS Paint" shines in dark. Easily made. 100 other formulas, plans—all 25c. Ideal Service, 301, Park Ridge, Ill.

REAL Manufacturing formulas. Lists free. Cummings, Chemist, Gordon Ave., Syracuse, N. Y.

AUTHENTIC Formulary 924 pages (illustrated). 10,000 money making formulas, recipes, instructions, substitutes. \$1.75 postpaid or C.O.D. (foreign \$2.10). Catalog 3c. Adams Brown Company, Chestnut Hill, Massachusetts.

FORMULAS—Latest, best. Analysis. Literature free. Belfort, Engineering Building, Chicago.

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LABORATORY Supplies at wholesale prices: Chemistry, biology, physics. Catalogue, 10c. National Scientific Co., 2204 W. North Ave., Chicago. Established 1908.

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SPECTROSCOPE For quick chemical analysis \$2.50. Kutting Sons, Campbell, California.

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EXTRA Dollars in selling magazines of all kinds. Attractive Christmas gift offers. Pleasant and profitable, full or part-time work. Now is the time to get new and renewal orders. Write for full particulars and selling kit. The Instructor Subscription Agency, Dansville, New York, Dept. PM.

CALL On friends with greeting card assortments: Easter, birthday, other occasions. Personal stationary; gift wrappings. Big profits. Experience unnecessary. Samples on approval. Wallace Brown, 225 Fifth Avenue, Dept. 834, New York.

WRITE For free fabric samples amazing stainproof tablecloths. Clean with damp cloth. Require no ironing. Beautiful patterns. Look expensive, long wearing, low priced. Commissions big. Also complete dress line. Melville Company, Dept. 3434, Cincinnati, Ohio.

DO You want a steady job with good pay? Work for U. S. government. Complete list of available positions, qualifications required and how to prepare for a civil service job. \$1.00. Guidance Service, Crosby, North Dakota.

AGENTS WANTED

SELL Dresses at low prices! Hundreds sensational bargains. Actual samples free. Send dress size, age. Harford, Dept. P-365, Cincinnati, Ohio.

"CAR Watchman" prevents thieves from stealing tires—gas—equipment. Amazing invention. Whirlwind seller. Big profits. Write quick. Northwest Electric Co., A-10, Pukwana, So. Dak.

SCHOOL Seniors—Sell America's most beautiful distinctive graduation name cards. Positively highest commission. Lowest prices. Free sample kit. Printcraft, 1423 E. Elm Street, Scranton, Penna.

I WILL Give you \$5.00 worth full size packages foods, groceries, soap, etc. Free if you agree to show friends and others. Amazing spare time money making opportunity. Write Zanol, 8315 Moonmouth, Cincinnati, Ohio.

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AGENTS—Salesmen. Add Rolyat Liquid Charcoal to your line. Information, Rolyat Foods Co., P.O. Box 263, Orange, New Jersey.

AGENTS Champion sample belt 25c, information 3c. Leathercraft, 844 W. Baltimore, Baltimore, Md.

DOLLARS Galore selling miracle gasoline saver. Sample 25c. Marshall, Box 161, Beeville, Texas.

AGENTS 5c; Retailers 25c. Inventor, 35P North 9th, Columbus, Ohio.

BIG Profits selling more miles from limited gas coupons, use Gastine, costs \$1.00, treats 100 gallons. Peppo can double battery life, ends recharging expense, costs \$1.50. Money back guarantee. Rush name for details. Barkley, B-1316 Arch, Philadelphia, Penna.

BIG Clothing bargains for big profits. Used dresses 10c, men's suits \$1.00, shoes 12½c, men's overcoats 50c. Over 100 sensational values. Experience unnecessary. Free wholesale catalog. Superior, 1250-DX Jefferson, Chicago.

AGENTS—Whirlwind profit opportunity. Finest silk Nylon, and Rayon hosiery. Big selection. Very latest styles and colors. Replacement guarantee. Your own hose free with large outfit. Rush hose size, name today. Wilknit, Dept. DA-37, Greenfield, Ohio.

SALESMEN Wanted — Attention all salesmen who may find it necessary to make a change because of inability to get supplies. A good Rawleigh route may be available near you. We manufacture over 200 products, nearly all household necessities, not requiring raw materials now needed for defense. Present supplies adequate. Good profits. If interested investigate at once. Write Rawleigh Co., Dept. A-150-PPMA, Freeport, Ill.

"**EAQLE** Album Pages" with your own titles. 250% profit. Samples, wholesale prices 10c. Mango, 565-S18, Newark, N. J.

SELF-POLISHING Shoe mitt. Sells like wild. Goodbye messy rags, cans, bottles. Shines shoes like magic. Samples sent on trial. Kistee, 124, Akron, Ohio.

SELL Perfumed novelties. Details, sample 10c. I. Koblinski, 25 State Park Drive, Bay City, Mich.

SAVO-GAS, Biggest moneymaker yet. Quarter brings sample. Marshall, Box 161, Beeville, Texas.

PATRIOTIC Photo card: New; different; agents cleaning up. Details. Art Supply, Box 617-M, Louisville, Ky.

BIG Money taking orders; shirts, ties, hosiery, underwear, pants, jackets, sweaters, uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AN Lincoln, Chicago.

DID You say easy seller? Just try Storm-Proof cigarette-cigar and pipe lighter. Here's your details—25c retail, \$12.50 hundred wholesale, including county rights. Storm-Proof Lighter Company, 126 Lexington Avenue, New York.

WHOLESALE Sources. 500,000 articles. Free directory. Maywoode, 1133 Broadway, New York.

BEAUTIFUL Approved crucifix sick call set. Fast seller to Catholics everywhere. Every Catholic home buys this beautiful combination crucifix and sick call set on sight. All essentials. Big profit order taking plan. Lowest selling price. Write for demonstrator offer and details. Midwest Religious Goods, 3127 W. Fifth Ave., Dept. 15, Chicago.

RELIABLE People wanted to place eggine in stores and appoint agents. Used the same way as eggs in baking and cooking at 10 cents dozen. Full size package and particulars 10 cents postpaid. Morrissey, 4417-21 Madison St., Chicago, Ill.

MAKE Money applying initials on automobiles. Also, sideline salesmen for short run decal name plates. "Ralco," 1483 Washington, Boston, Mass.

AMBITIOUS School seniors—Sell classmates the "tops" in graduation name cards. Best commissions. Free cards. Agencies going like wildfire. Hurry! Craftcards, Box 235-L, Pittsburgh, Penna.

AGENTS. Big line including food products. Fast selling premium and bargain deals. Low prices. Send card for big outfit over with gift. Ho-Ro-Co, 2737 Dodier, St. Louis, Mo.

FREE Water and our concentrates, makes flavors, lotions, shampoos, 72 products, labels, bottles furnished. Quico, E-20030 Russell, Detroit.

SCHOOL Seniors—Sell graduation name cards. America's largest, fastest-selling, low-priced display, 35% commission. Free cards. Universal Engraving & Printing, Box 745-PM, Pittsburgh, Penna.

USED Men's shoes 14c, hats 12c, pants 28c, dresses 10c, winter coats 50c, fall coats 35c. Bargain catalog free. Portnoy, 566-V Roosevelt, Chicago.

SEND For free copy of illustrated wholesale Christmas catalog! Forty profitable lines! Ellico, 438 North Wells, Chicago.

AGENTS—300% Profit selling gold leaf letters; stores and offices. Free samples. Metallic Letter Co., 438-B North Clark, Chicago.

AGENTS: Stamping names on pocket-key protectors. Sample check with your name, address, 25c. Stamping outfits. Emblem checks, check-fobs, name plates. Hart Mfg. Co., 363 Degraw St., Brooklyn, N. Y.

WANTED Men to start business for themselves. We start you. Make \$1,000.00 month. Send stamped self-addressed envelope. Akron Rug Co., 5 N. Adam St., Akron, Ohio.

DO You want agents for your proposition? Your ad in this space will place your message before hundreds of men seeking fast-selling products. My folder "How to Secure Agents" is filled with proof. I'll gladly send you a copy free. P. W. Johnson, Manager Classified Advertising, Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

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ADVERTISING Book matches at sensational low prices. 2500 books printed black on silver with customer's ad \$6.95 including tax, your commission. Write today for free outfit. Chicago Match Company, Libertyville, Illinois. Dept. PM-1.

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ADVERTISING Book matches. America's largest manufacturer of union label book matches. Fast selling line. Large sales producing kit. Sample matches. Complete cut catalog, 17 color combinations makes selling easy. Commission in advance. Superior Match Company, 7030 Greenwood, Dept. M-1, Chicago.

PATENT Solicitor to represent old established firm. Part time. No experience necessary. Liberal commissions. Write W.A.S., 332 Wells Building, Milwaukee.

EARN Money in your spare time taking subscriptions to Popular Mechanics. Unlimited possibilities, every family a prospect. Easy to sell. Bonus paid in addition to liberal commission. Send postcard for further details today. Circulation Dept., Popular Mechanics Magazine, 200 E. Ontario St., Chicago.

RETAILERS Need ceiling price markers, price markers. 50% advance commission. We deliver, collect. Price Tag, 1445 Montrose, Chicago.

BIG Commissions—selling to stores celluloid pricing tickets, metal shelf moulding. To restaurants, menu covers, signs. P. Pricing Press, 124 White St., New York.

ADVERTISING Book matches—World's largest "direct selling" book match factory offers advance cash earnings calling on every type of business. Men or women. Experience unnecessary. Full, part time. Low prices. High quality. Quick deliveries. Powerful patriotic display. Repeats. Free kit, instructions. Match Corp. of America, 3433 West 48th Pl., Dept. E-1, Chicago.

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NEW Writers wanted to re-write ideas in papers, magazines, books. Splendid opportunity to "break into" profitable writing field. Rush postcard for free details. Comfort Writer's Service, Dept. FJ-149, St. Louis, Mo.

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"**UNCLE** Sam" jobs! \$105-\$175 month. Big opportunity. Men-women. Prepare immediately for examinations. Full particulars—list positions, free. Write today sure. Franklin Institute, Dept. T2, Rochester, N. Y.

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CARTOONING Course:—30 illustrated lessons, over 600 sketches, \$1.00 postpaid. Montes Studio, Box 892, Pasadena, Calif.

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CHALK Talks. Laugh producing program, \$1.00. Catalog 10c. Balda The Cartoonist, Oshkosh, Wisconsin.

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FREE—New Advertisers Rate Guide, 44 pages. Includes everything. Lowest rates. E. H. Brown Advertising Agency, Merchandise Mart, Chicago.

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FREE—"Amazing New Book"—"Profits From Classified Advertising." Tells how and what to advertise. Be sure to read this book before you invest one cent in advertising. Remember—it's free! Write for your copy now. F. W. Johnson, Classified Advertising Manager, 200 East Ontario Street, Chicago, Illinois.

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SOUTHERN Mail address. Receiving, forwarding, \$1 month. Exchange, Box 86, Atlanta, Georgia.

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3 LINES 30c; Cushioned, indexed, 35c. Signatures \$1.50. Stamprite, Wauwatosa, Wis.

2 LINES 25c, 3 Lines 35c. Stamp Works, Auburn, Neb.

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FIRST Quality printing—Reasonable. Samples. Treaster Printing Service, Milroy, Pennsylvania.

125 8 1/2 x 11 LETTERHEADS And 125 6 3/4 envelopes neatly printed \$1.25. John Ferreira, 220 Almy St., New Bedford, Mass.

200 LETTERHEADS Or envelopes printed \$1.25 postpaid. W 3 J H P, Pottsville, Pennsylvania.

125 "VICTORY" Letterheads, envelopes, both \$1. Courier Press, West Liberty, Kentucky.

200 PERSONAL Letterheads, 100 envelopes \$1.50. Strang, 48 Stockwell Street, Painesville, Ohio.

8 1/2 x 11 FORM-LETTERS Multigraphed, \$3.50—1000. (Automatic multigraph for sale.) Manzo, 568-818, Newark, N. J.

125 8 1/2 x 11 HAMMERMILL Letterheads, 125 envelopes, 4 lines, both \$1.35. Gooch, 202PM, Hernando, Miss.

CUTS, 2" x 3", from drawings and photos \$1.00. Joe Reik, 118 Gazette Ave., Lexington, Ky.

MIMEOGRAPHING: Letters, circulars, cards. Free samples. Arthur Thraen, Harlan, Iowa.

\$1.00 POSTPAID: 100 8 1/2 x 11 Bond letterheads and 100 envelopes, Benneville, 907 West Roosevelt, Philadelphia.

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5000 ELEGANT Envelope slips, \$3.75; 6x9 circulars, \$8.00. Folders, stationery—all printing—lowest prices. Samples. Goodprint, Harrisonburg, Va.

SPECIAL: 200 Bond letterheads, envelopes, 59c. Joseph Johnson, 1382 Fifth Ave., New York City.

CENTRAL West Printers, Leading mail order printers. 3228-P Jackson, Chicago.

ASK For quotations. Letterheads \$1.95. Free samples. Wilson Press, 1724 Monroe, Madison, Wisconsin.

6x9 CIRCULARS—1000, \$2.95. All kinds printing. Lowest prices. Reporter, Chelsea, Oklahoma.

HAMMERMILL Letterheads, envelopes, any color, 39 type styles. Free particulars. Woodruff's, 217-A4 Lewis, Duluth, Minnesota.

BETTER Grade printing reasonable. Estimates on anything. Economic Press, Leonia, N. J.

500 3 1/2 x 7 1/4 FOUR Line gummed stickers, 25c. Moritz Printery, Saginaw, Mich.

WANTED Printing of all kinds by thousands of our readers. Your ad in this space will bring you some nice orders. Write for positive proof. F. W. Johnson, Classified Advertising Manager, Room 304, 200 East Ontario Street, Chicago.

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INEXPENSIVE 6x9 Printing press. Details free. Novelty Shop, Downsview, Louisiana.

PRESSES, Type, illustrations, strip-material, cabinets. Complete supplies, Bargain bulletins. Send stamp. Bradshaw, 3214-P Huron, Chicago.

PRINT Your own cards, stationery, circulars, advertising. Save money. Simple rules furnished. Print for others, nice profit. Junior outfit \$8.25, senior outfits \$17.38. Details free. Kelsey, Inc., T-11, Meriden, Conn.

PRINT At home. 10c will bring a complete catalog of presses, type and supplies. P. Peiffer & Company, 6 Columbia St., Newark, N. J.

BARGAINS—Presses, type, supplies. Send stamp. 150 Harvard, Cambridge, Mass.

USED Presses, type, supplies. Lists 3c. Turnbaugh Service, Laysville, Penna.

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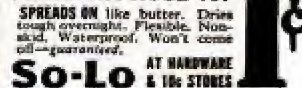
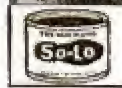
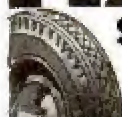
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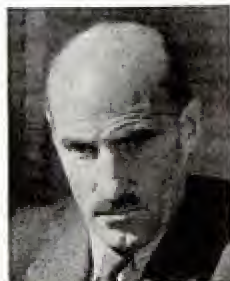
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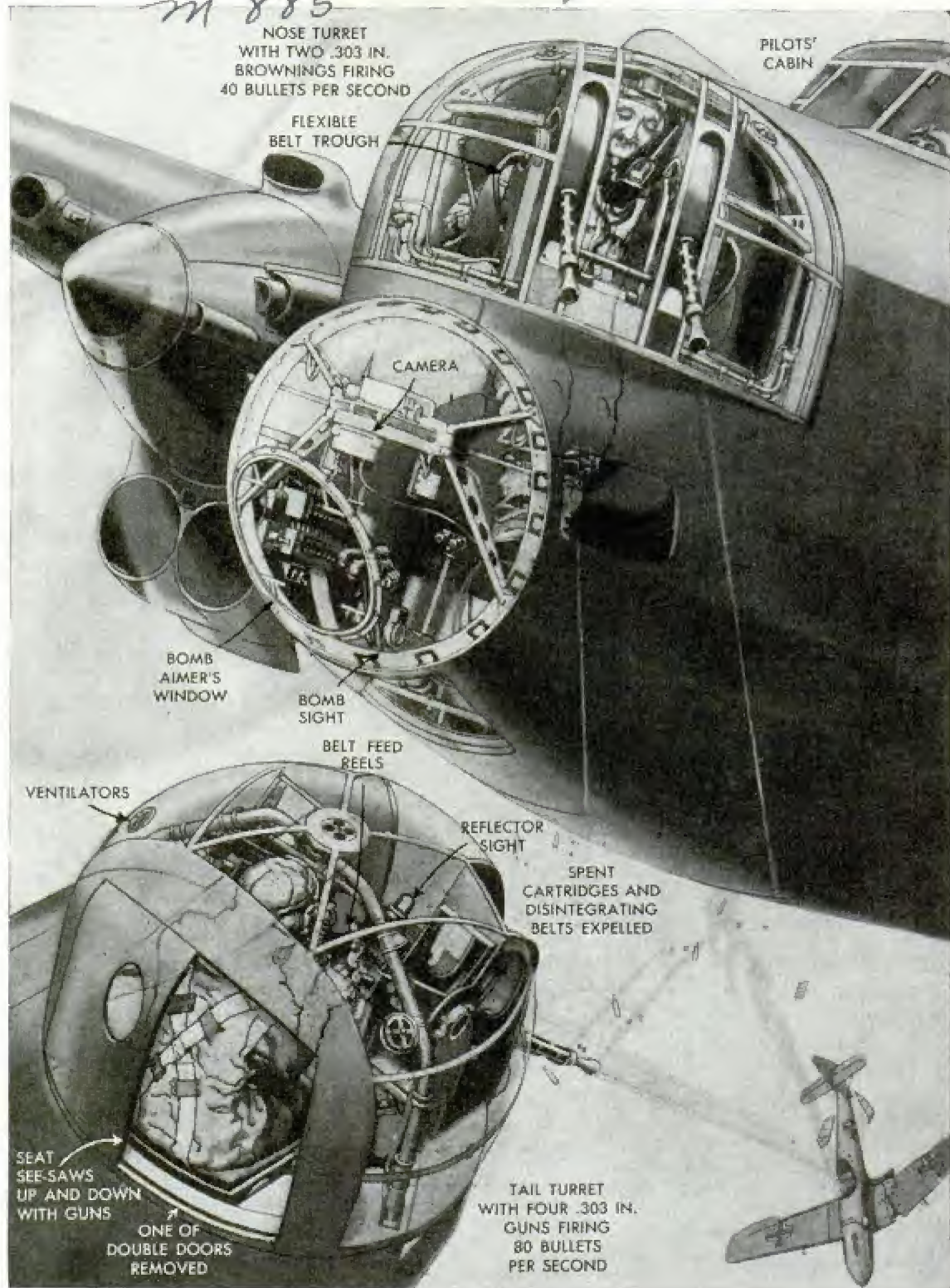
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London Electralype Agency, 134 Fleet
 St. London England
Pivoting Gun Turrets Protect British Bomber

m 885



Copyright S. W. Clatworthy

Hailed in England as the "second greatest invention of the air war" is the hydraulically operated gun turret which eliminates need of a fighter escort for long range bombers. Nose and tail turrets of a big twin-engined Avro Manchester bomber shown above mount guns that can blast the enemy from the sky with a total of 120 bullets a second. The nose turret can be swung to right or left by the gunner. Seat for rear gunner goes up and down with the guns. British consider their eight-gun fighters the No. 1 air invention

Popular Mechanics Magazine

REGISTERED IN U. S. PATENT OFFICE AND CANADA

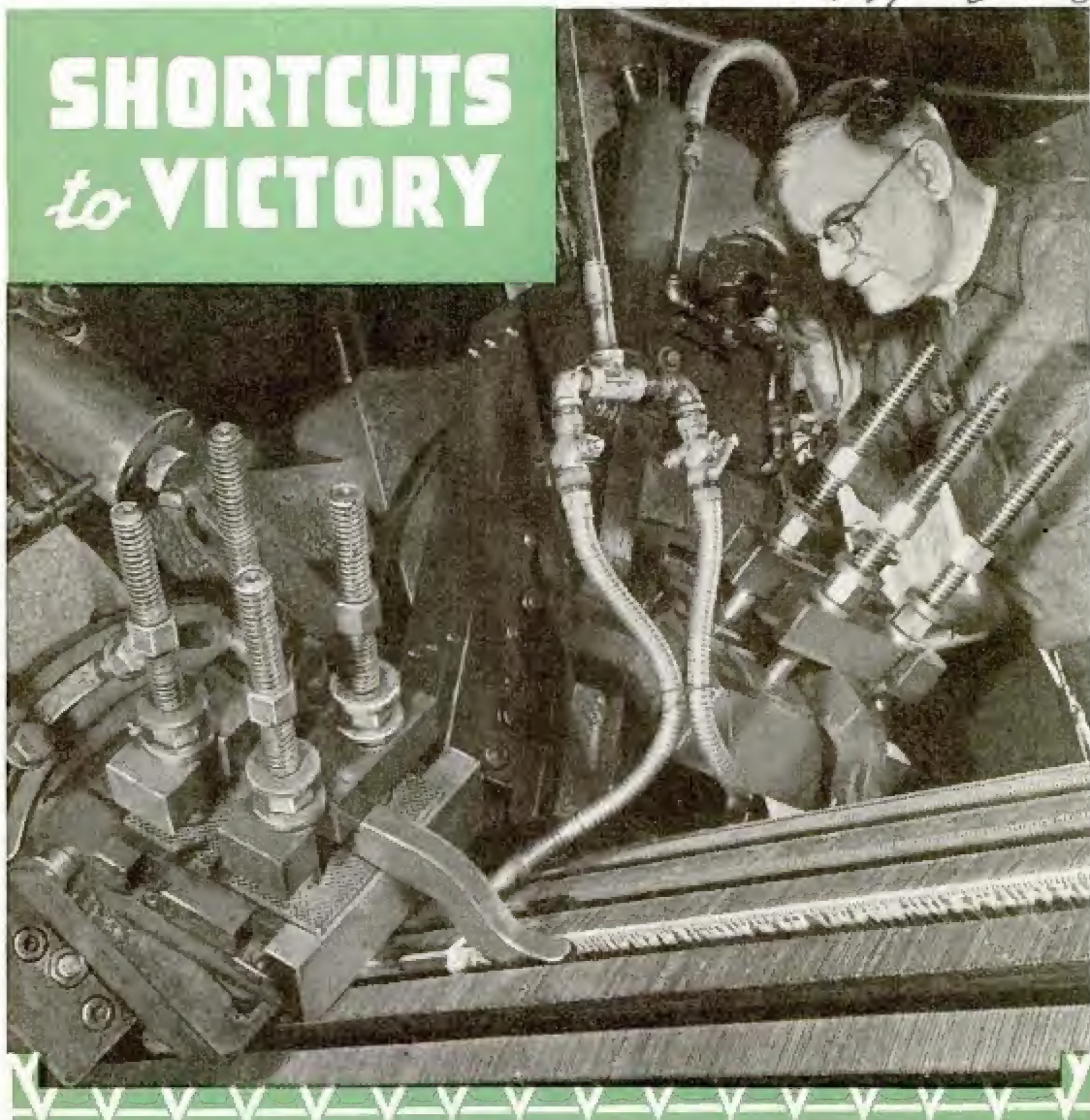
WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 79

JANUARY, 1943

No. 1

SHORTCUTS to VICTORY



This Westinghouse worker suggested an automatic compressed-air device to lift the steel-cutting tool above the work while the 14-ton rotor glides back for next cutting stroke, speeding rotor production by 40 percent

BECAUSE there is so much to do and so little time to do it, America's "production soldiers"—the man at the machine, the man in the laboratory and the man in the engineering shop—are devising ways and means of doing their individual jobs faster and more efficiently, thus speeding

the day of complete victory over the Axis.

Suggestions for simplifying production methods and ideas for reducing the time required for testing and assembly are pouring in by the tens of thousands to management executives of this nation's war-goods plants. And a large percentage

JANUARY, 1943

Con: Julian P. Laygett
2200 Far Hills av, Oakwood,
Darston, Ohio

1

John White



A few shakes of tray devised by Bell Aircraft worker turns antenna beads on end for stringing

method reduced the time for rifling the barrel of an automatic cannon from three hours and 25 minutes to 30 minutes.

A 62-year-old "production soldier's" idea for doing his job 40 percent faster earned for him the largest award presented by Westinghouse Electric and Manufacturing Company for more than 2,000 employe suggestions accepted in 1941 at the East

Pittsburgh works. This idea resulted in the development of an automatic tool lift for machining rotors—essential parts of electric generators which are needed to meet the expanded power requirements of the nation. Not only does this machine increase rotor production by 40 percent, but it eliminates tool breakage.

An assembly fixture, designed in spare time by another "production soldier" and manufactured from scrap materials, has raised the output of certain parts for army



It took one man's full time to operate spindle of drill press (left). He suggested weights on handles to pull tool into work; now he can work two spindles



Metal yoke, below, rigged by General Electric man halves time for making bearing rings for warships. One boring mill does work of two mills and a lathe

of these "shortcuts" to victory and peace is being put into immediate operation.

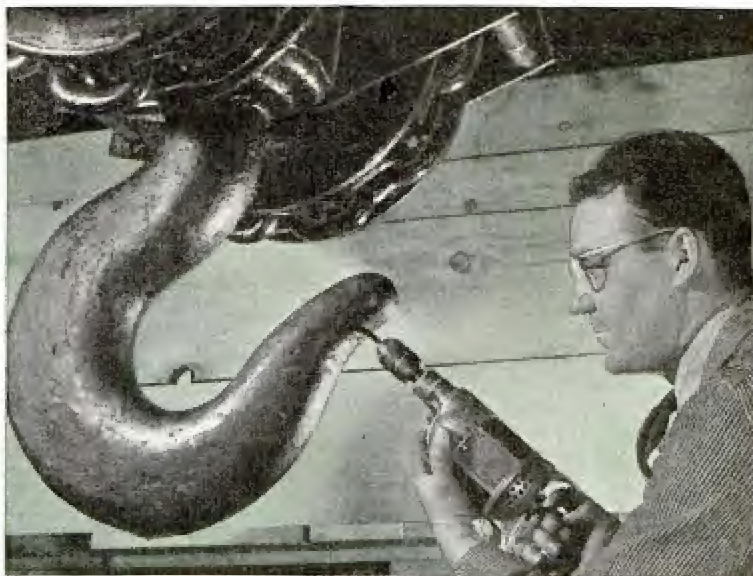
For instance, in one plant manufacturing cannon, it has been found possible to substitute a single machine for ten machines formerly required to accomplish the same work. This reduced the time on a gun barrel operation from one and one-quarter hours to four minutes. In another plant, introduction of the broaching



tank fire extinguishers from 100 to 400 parts per eight-hour working shift at Walter Kidde and Company. Another worker devised a scrap steel device that increases the output of another part by 25 percent, speeding the production of extinguishers used in aircraft.

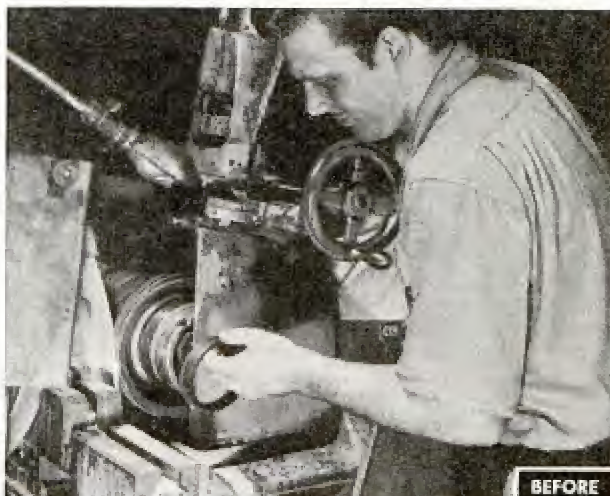
These are only two of the many tangible results of a work-simplification program in operation at the Kidde plants. The basis of work simplification is the fact that the man on the job often knows more about improving that particular job than a highly trained engineer. Under the Kidde program, the men at the machines work out their own ideas and present them as accomplished facts. The starting point is the foreman or group leader. Regular classes are held for these men to acquaint them with the principles of motion study, expressed in simple shop language rather than engineering terms. In these classes, the men are given assistance in working out their own ideas. In addition, a machine shop completely equipped with hand and power tools has been provided for the employees so they may develop their own devices. Not only is each man given full credit for every suggestion he makes, under the theory that a stolen idea is the worst form of sabotage, but in addition, the individual worker is encouraged to give credit to those who have helped him develop his idea.

At Bell Aircraft Company is a machine that spits out some 400,000 rivets per day from spools of alloy wire—a highly valuable invention because Airacobra, the cannon-carrying pursuit plane, requires thousands of rivets. The brain child of a Bell employe, this machine meets the need for equipment capable of extremely accurate production of flush-type rivets. This same "idea man" is responsible for the pantograph router, which quickly and cheaply cuts out

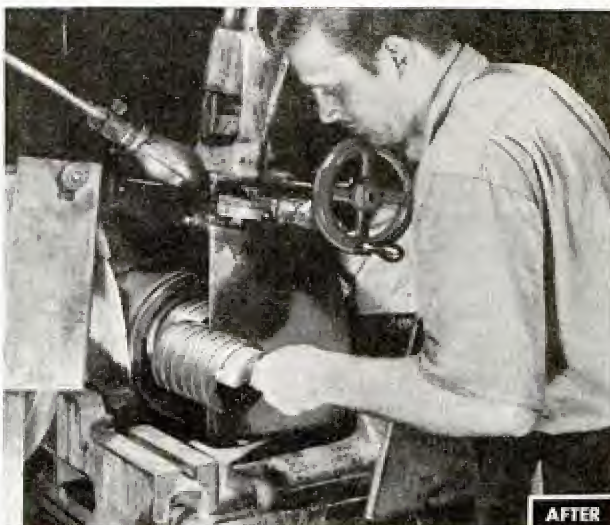


Instead of sawing off a piece for microscopic analysis, a tubular drill bores out a sample from tip of 50-ton crane

By installing a loading arbor, several pieces can now be loaded on centerless grinder, vastly increasing production



BEFORE



AFTER

Lewis Wright



AFTER



BEFORE

This man made his job of removing a burr from bushing of connecting rod easier and at the same time got better results, by using a ball covered with emery paper, turning it with a bit brace

complicated parts from raw aluminum stock at a rate of as many as a dozen at a time.

Bell encourages employees to translate practical ideas into usable manufacturing methods, having set up an organization which protects the employees against theft of inventions. Rather than have an employee submit an idea for an improvement while it is still nebulous, he is encouraged to consider carefully the primary purpose of his invention, to determine whether it represents a definite improvement over

existing practices and to decide how it can be made most economically and used efficiently. Once an invention has been developed to this point, a disclosure is made, using a standard form, with sketches or drawings attached. Once properly dated and signed by the inventor, it comes before the special organization, a Patent Board. If the board's decision is favorable, the invention is assigned to the company and the inventor receives cash awards, plus a share in royalties received by the company from outside manufacture or use of the device.

More than 40,000 suggestions for speeding or improving war goods production came from General Electric employees in 1941, with more than 12,000 proving worthy of acceptance. In line with its reward program for encouragement of employees, the company paid close to \$100,000 for the suggestions adopted. One worker won a substantial reward for an improvement in calibrating radio transmitters, another cut in half the time required for a

step in the manufacture of bearings and bearing rings for battleships, while a third made it possible to save thousands of pounds of a special steel by suggesting a way to cut it in strips $\frac{7}{8}$ of an inch narrower. Marine turbine work has been speeded up through a worker's idea for eliminating the need of special tools at one point. The copper and also the paper insulation are salvaged from old coils when the wire is drawn through a die devised by a General Electric employee.

At the request of the War Production Board,

(Continued to page 176)



To avoid twisting strains, bolts for turbines are tightened with aid of 110-volt electric heaters that lengthen bolt enough to give the nut an additional turn

acme Newspictures, Inc.
46. - 8 av, N.Y.C.

One-Ton "Block Buster" Tested by U. S. Army

"Stopped" in midair by the photographer, the "block buster" looks → small and innocent compared with Army bomber

But more formidable is a close-up picture of the deadly 2,000 pounder riding an electric winch through the bomb bay



Two - thousand - pound aerial bombs that will demolish an entire city block were tested recently at the Army Ordnance Proving Ground near Aberdeen, Md. The new "block buster," designed by ordnance engineers, is lifted into the bomber by an electric winch. Army cameramen who photographed the tests conducted by the Army Air Corps had to stay a mile from the bomb's target for safety.

Hydraulic Extractor Pulls Rails From City's Pavements

Tearing up abandoned trolley tracks in the scrap metal drive is a fast operation for a hydraulic rail puller recently put into use. It does the work with minimum disturbance and damage to surrounding pavement. The machine includes large iron beams running parallel to the tracks which lift the rails while also pressing downward to keep from dragging up too much of the adjacent pavement. It is said that the extractor can rip out a lineal mile of track per day from asphalt, and 2,500 feet from cement.



Hydraulic lifters raise beam to uproot tracks from city's paved streets

JANUARY, 1943

Lebar Lion Works
New Haven, Conn

Mr. Kenneth Aldridge -
New Haven, Conn

British Combs & Shales, Ltd.
271 Madison av nyc.

Freighter's Rocket Gun Snarls Plane in Wires

Halman projector



These rocket projectors send aloft parachutes from which wires dangle to ensnare enemy planes

It is no longer a secret that the British Admiralty has armed its merchant ships with rocket apparatus which has proved one of the most successful defense weapons against attacking planes. These guns project rockets which carry high into the air

long wires suspended from a parachute. As the chute drifts slowly down, the wires offer a grave menace to the enemy planes. The diving pilot is kept high or forced to swerve and miss his aim, frequently dropping his bombs wide of the freighter.

"Glider" Bike Reduces Pedaling With Dual Chain Drive

You can glide more than half the time while riding a bicycle built with a dual drive instead of the old style crank, according to its New Orleans inventors. The bicycle has a crank arm and chain on each side with the arms connected directly to the chains by special bearing links. The links pass completely around the sprockets on each stroke. The pedals are attached to sliding sleeves over levers fastened to the frame. A "gear shift" lever raises and lowers the pedals to shorten or lengthen the strokes. The bicycle has a 55-inch wheel base and the seat is only 26 inches high.



Dual chains driven by two levers apply continuous overlapping power, giving almost equal force the full length of each stroke

6 Wm. E. Hendricks
Glidercycle Sales Co. Box 362,
New Orleans, La.

POPULAR MECHANICS

cont: Allen Warren Elliott 7 Pack Ave.
N.Y.C.

DRAFTING OUR FORESTS



m 901
By Harris Collingwood

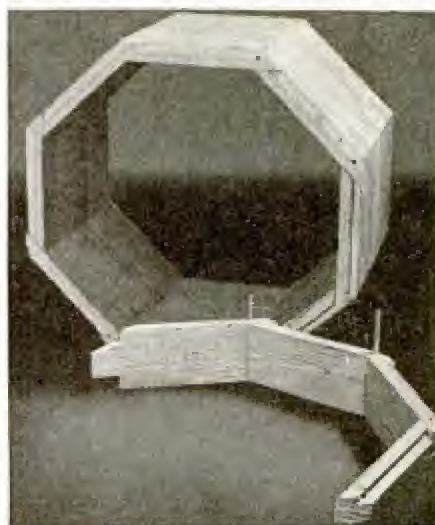
Chief Forester, National Lumber Manufacturers' Association

TREES are America's greatest crop. They cover one-third of the nation. Unlike other natural resources, our vast timber reserve is constantly being renewed because many new seedlings spring up when one old and over-ripe tree is harvested.

It's fortunate that this is the case, because trees, too, are being called for "selective service." Under approved modern logging methods only those trees which have reached maturity and might soon start to decay are harvested. This prevents waste and makes room for a new timber crop.

There are plenty of trees today—and there will

Giant Oregon firs, above, respond to call under "selective service" for war needs. Below, section of wood culvert designed to release metal for U. S. war production

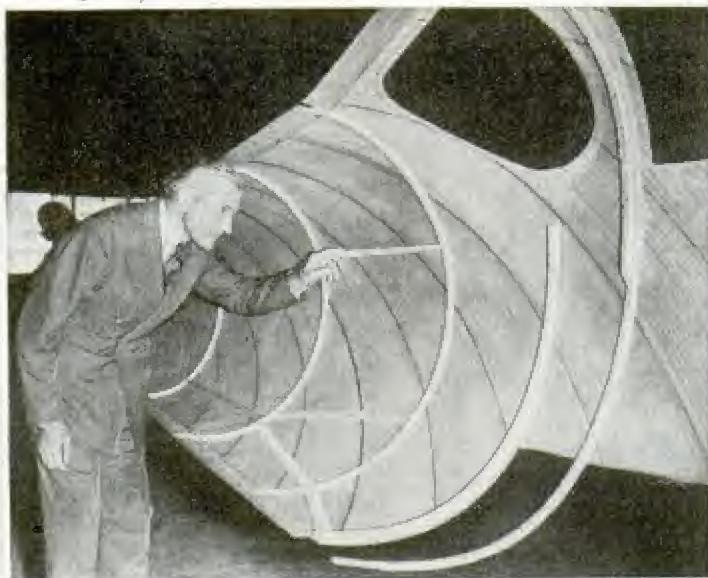


Installing wood culvert made of interlocking sections requiring no precious metal. This culvert is built to support thousands of pounds

JANUARY, 1943

Ref: Harris Collingwood, Chief Forester, National Lumber Mfgs. Assn. 90 American Forest Prods. Industries.

File 4884391



Inspecting airplane section made of wood and plastic used in construction of both combat planes and "flying boxcars" to save metal

be plenty tomorrow—because nature is being aided by the forest products industries. The men who supply our fighting men with wood to help win the war have as their objective a program of conservation which will insure abundant wood for all time.

Without wood to take its place for hundreds of purposes, America would not have metal enough to win this war. One single army order called on wood to save 275,000

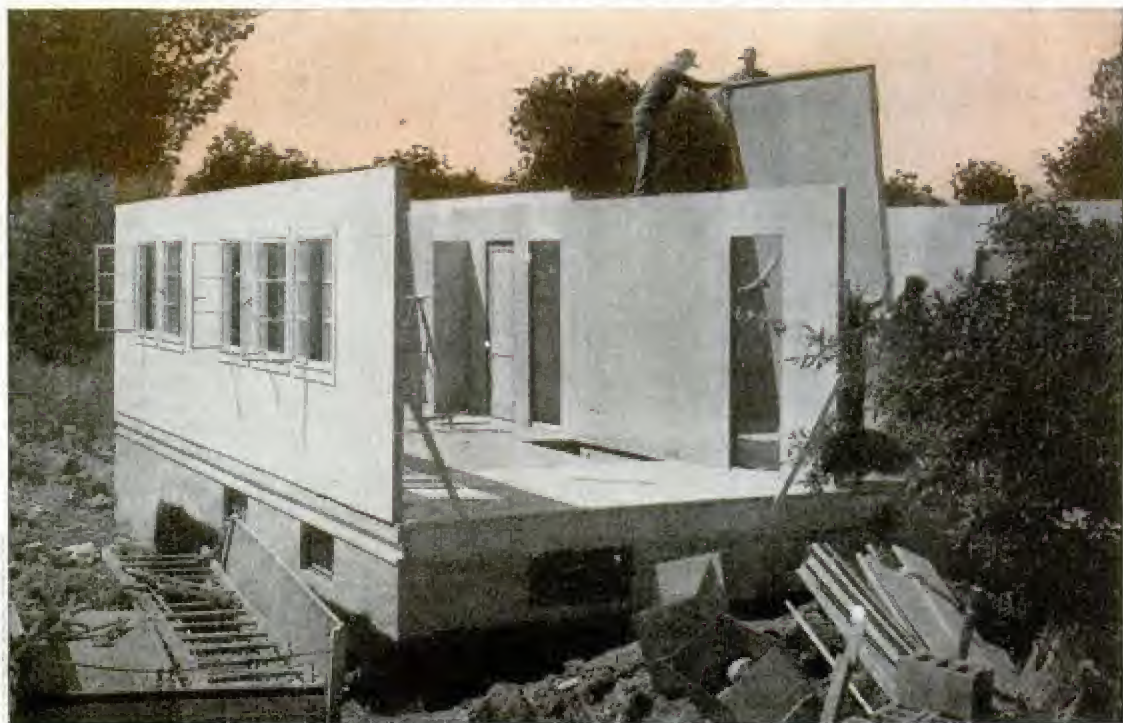
tons of steel a year—enough to build 30 large cargo ships. That particular saving comes from building military truck bodies of wood. The development of wood lamination and weatherproof plywood makes this possible.

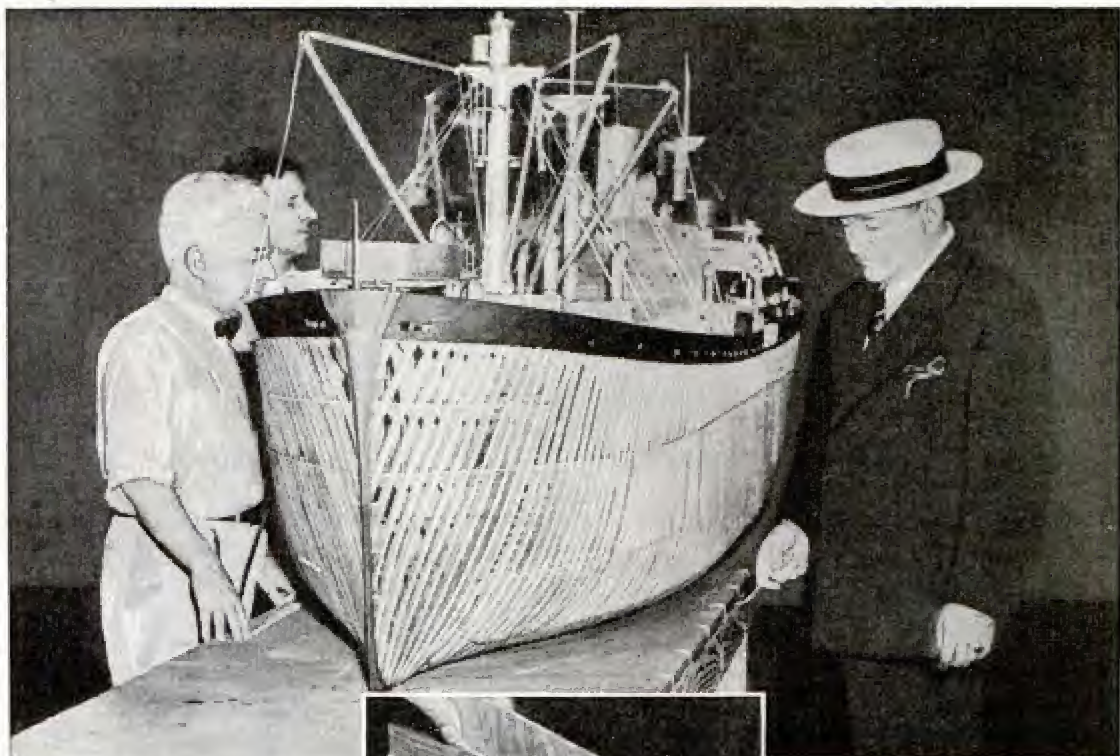
Commercial truckers are taking a leaf out of the same book. Many are rebuilding van bodies with plywood in order to save weight and increase their pay loads. Vans which weighed 10,400 pounds with steel bodies weigh 7,025 pounds with bodies of plywood. This helps solve the transportation problem and the old steel bodies help relieve the scrap metal shortage.

An initial army order for a quarter of a million specially designed demountable wood beds marked replacement of folding steel cots formerly specified. This saved steel enough to lay 376 miles of railroad. It was the first of what will be a continuing series of similar orders. Folding wood chairs are replacing the steel chairs in army use.

The army's new wood beds are more versatile than the steel cots. The cots

Erecting a prefabricated house for a defense worker takes only a few hours with full-wall plywood panels containing windows and doors installed at the factory—a boon to war housing





could be used only as single beds. The new demountable wood beds can be used either singly or locked together as double-deckers, saving floor space, without the use of metal for straps or bolts. Their construction is so simple any home woodworker can make similar beds for his own use.

The army has already listed more than 400 items of military supply for which wood must be used instead of metal. The navy's list is almost as long. The War Production Board has stopped the use of metal for more than 700 civilian products. Upwards of 100 of these are hardware.

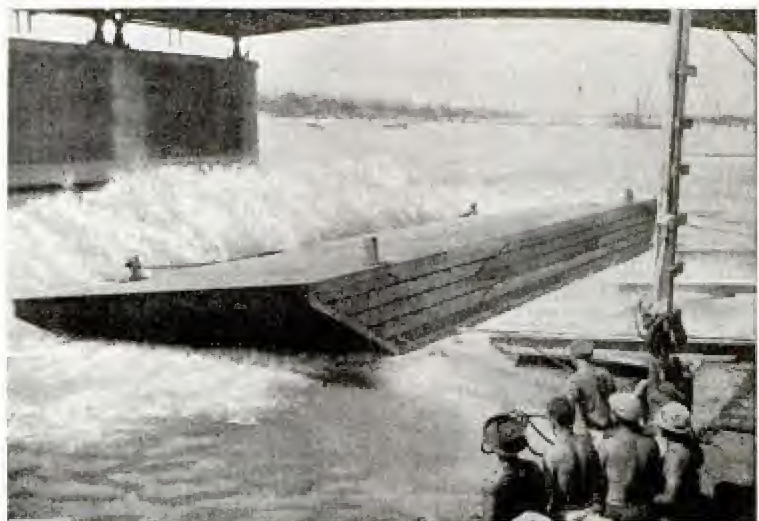
When the war is over, lessons on the use of wood learned during the emergency will be turned to the needs of civilian industry. Many are serving certain industries already. Consider one of

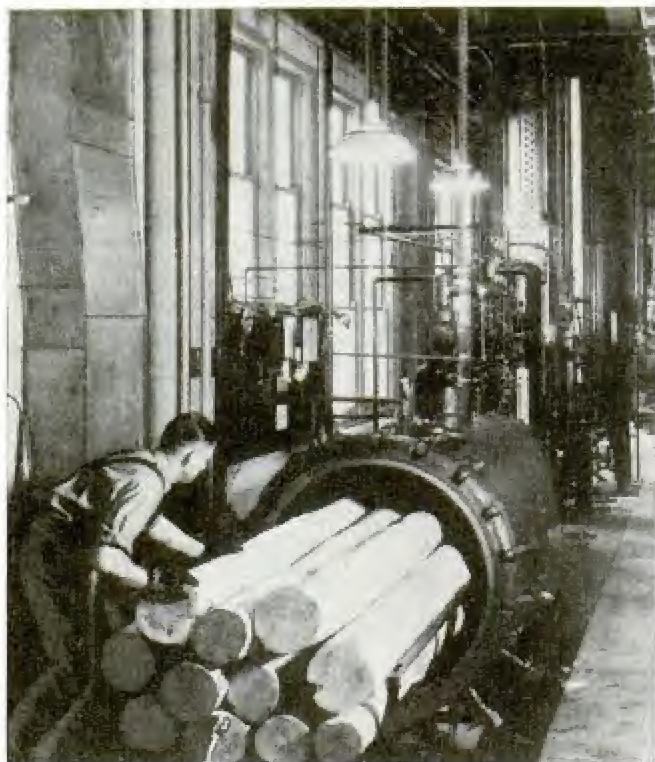


Inspecting wood model of Liberty cargo ship which has fir plywood interior fittings to reduce weight and save time in building these vital freighters

Left, secret of strength in the Douglas fir plywood is cross-banding of grain in alternate layers which are held together with synthetic resin adhesives

Launching wooden pontoon, below, for emergency bridge to be used in case the regular span is destroyed. Army engineers could make use of similar pontoons





Inserting wood piles in huge "tube" for laboratory test which will determine resistance to weather—foe of wood or metal

the most inconsequential—toys. Or is it true that toys are unimportant? They do not help directly to win the war, but they do boost the morale of the nation's children. Parents worry if their children are not happy. This dims their war ardor. War or no war, children must not be forgotten by Santa Claus.

Two years ago the manufacture of wood toys was in the doldrums. Steel toys held most of the business. Even most dolls were made of what are now critical materials.

The day after Pearl Harbor many toy makers turned their designers loose on wood. From their drafting boards have come everything from wooden toy soldiers, sailors, nurses, and WAAC's, to velocipedes and children's bicycles. Many of the bikes do not have so much as a bolt or screw of metal. The army, by the way, is testing nuts,

Life was never like this for the Three Little Pigs—a prefabricated hog house of fir plywood

bolts and washers made of wood.

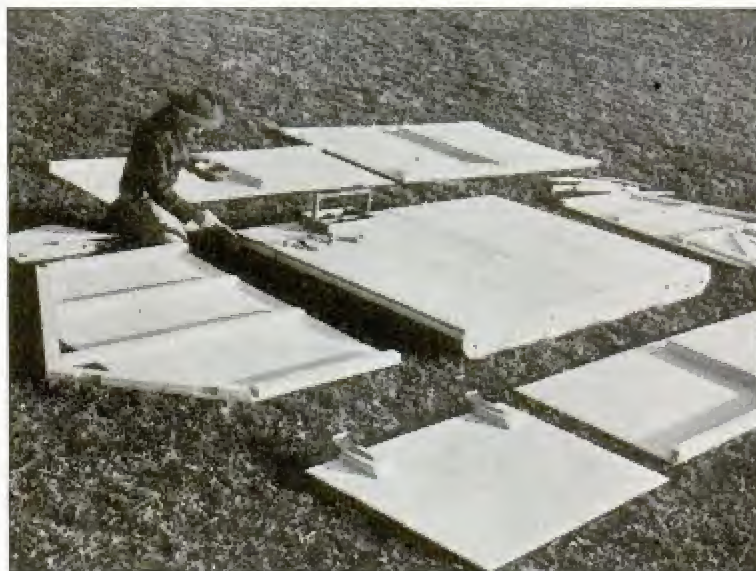
Model munitions factories for war workers' children, toy cantonments, ships, tanks, trains, jeeps, motorized guns, and airplanes are made of solid wood, plywood, or wood plastic. Wood will give children this year a wide selection of games and toys. In many communities hobbyists with home workshops are turning out wood toys for local sale. Thousands of parents are finding relaxation and satisfaction in making their own children's toys.

Waterproof and weatherproof plywood was invented and proved just in time for this war. Plywood airplanes are far past the laboratory stage. At least 15 American manufacturers are making them. Both the army and navy have plywood trainer planes. Plywood combat planes are in action in Europe. The Italians have four types of plywood bombers. One of the Russians' best fighters has plywood

tail and wings. Plywood will not splinter in a crash or "flower" when hit by bullets. It is not subject to the fatigue which plagues metal near welds, because plywood does not have to be welded.

Resin-bonded plywood can be "cooked" under steam pressure around a form to any shape desired. The process finished, it is rigid as steel.

The so-called "plastic" airplanes are not made of plastics. They are made of resin-



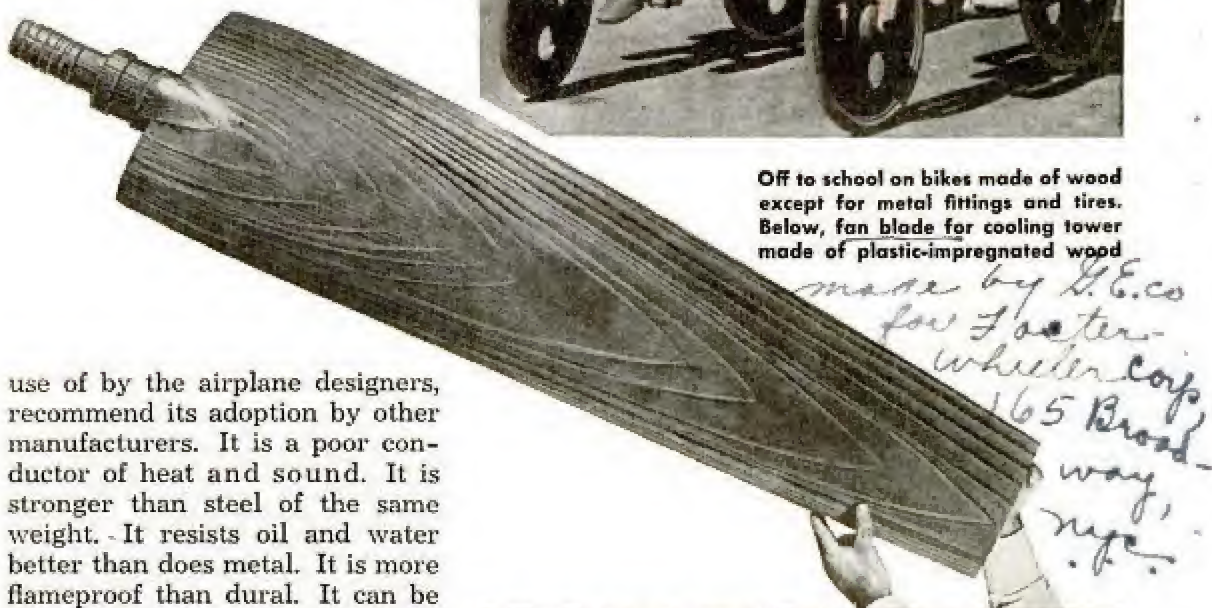
bonded weatherproof plywood. Development of plywood combat planes in this country and England is a military secret. Production of plywood transport planes for our army is not. Curtiss-Wright is making them in Louisville. They will carry either supplies or men.

These "flying boxcars" have a greater wingspread than the old commercial "skyliners," and are faster than metal planes. Plywood airplane "skins" do not have to be riveted, and they do not "ripple" at high speed. Both circumstances reduce air resistance.

Other special qualities of the new waterproof plywood, made



Off to school on bikes made of wood except for metal fittings and tires. Below, fan blade for cooling tower made of plastic-impregnated wood



use of by the airplane designers, recommend its adoption by other manufacturers. It is a poor conductor of heat and sound. It is stronger than steel of the same weight. It resists oil and water better than does metal. It is more flameproof than dural. It can be painted like any other wood, or left in its natural wood grain.

These are among the reasons both navy and army are making thousands of plywood boats for auxiliary combat use, from the "mosquito boats" that made history at Bataan to pontoons for the engineers. Plywood boats average a third lighter and a third stronger than boats of the same size made of metal. The builders say, they can "turn them out like popcorn."

The reason this is possible is twofold. There is a large reservoir



This portable first-aid chest is so light a soldier can carry it easily on his back

*F. Schumacher & Co
60 W 40 St. N.Y.C.*

from Weedinghouse N.Y.C. plant



Wooden "victory pump" for extinguishing bombs, small fires or watering garden uses no critical metal

shape. Shower-bath cabinets of that material are also in production. Any householder with a little skill and a set of joiner's tools can make his own. Plywood sheets are worked like any other wood. Kitchen sink drainboards, cupboards and cabinets, are made of the same material. A thousand new refrigerator cars made for the Pacific Fruit Express Company are lined with plywood. Refrigerator manufacturers have taken note. Frozen-food lockers are made of the resin-bonded wood.

Tobacco hogsheads used to be made of oak staves. Army and navy needs have made such hardwood a strategic material. Now Douglas fir plywood makes barrels of every size from keg to cask. But coopers throughout the country have leaped back to action using nonstrategic stave woods. A Massachusetts manufacturer is making

waterproof wooden pails. If incendiary bombs should strike your house, you can pump water out of such a pail, with a wooden stirrup pump. Blackout panels are made from plywood, or from lightproof paper made for that purpose.

The ban on metal containers has



Left, these crates look like dog kennels but they're used to ship big radio tubes.

Below, testing durability of wood packing box in revolving drum; it passed test

of experienced woodworking labor and there is an abundant supply of this vital raw material. That's because modern forest management aims to put America's forest acres on a sustained-yield basis which will result in trees growing as fast as we need them.

Not all the navy's wood auxiliary boats are made of plywood. Mine sweepers building in Cleveland yards are made of the same sturdy white oak as that which built the ships with which Perry won the Battle of Lake Erie. Timber for the keels and hulls of these mine sweepers is cut within 60 miles of the Cleveland boatyards.

Bathtub and kitchen-sink manufacturers are now denied iron. Some are already turning to waterproof plywood, molded to



turned packaging over to raw wood and plywood, paper, glass, and plastics. Both safe and sturdy packaging and light and compact packaging for the nation's supplies is one of wood's greatest wartime roles. Every ounce and every inch that can be saved in shipping weight and bulk means so many more supplies can go to the front. Every pound of metal that can be saved means that much more munitions.

New wood packages range all the way from shipping crates for high power radio transmission tubes, resembling kennels with peaked roofs and windows for inspection in transit, to "cans" made of several plies of paper and plastic film laminated together. This material can be made into tin-can shape, square boxes, or bags, depending on what it is to package. Fiber and paper boards are also being put to new uses. Specially treated papers protect particular products. Immensely heavy paper bags replace burlap. These paper products and many others are all made from wood.

Bottlers are hard put to find bottle caps. Even ketchup may soon be put up in collapsible tubes, like toothpaste. Most of the tubes will be made of pliable plastics.

Plastics are made of cellulose and lignin.

(Continued to page 177)

Sailor Wears Foul-Weather Mask

Sailors convoying supplies to our fighting forces in all corners of the earth wear "weather armor" as they watch for surprise attacks from enemy submarines. An innovation used in the far north is the foul-weather mask covering all the face except for slits at the eyes, nose and mouth.



JANUARY, 1943

*Int'l. News Photos, 235
E. 45th St. N.Y.C.*

'Umbrella' Tail on Bomber Brakes Speed of Dive



As bomber noses into dive, top, "umbrella" brake starts opening. At end of the dive it is open fully

In the new German Dornier Do. 217E all-purpose bomber, air-brake flaps have been built into a tail extension, in addition to the customary brake flaps under the wings. This installation adds dive bombing to its other achievements which include precision bombing, torpedoing and mine laying. Parallel with the tail while in level flight, the four flaps are spread outward like an opening umbrella as the ship starts downward, exerting their full braking power at the lowest point of a dive. Immediately upon leveling off, the brake flaps are closed to their original position where they do not retard the flight. If necessary the pilot can release and cast off the entire dive-brake assembly.

*Some newspaper pictures
461-8 av, N.Y.C.*

The EARS of the FLEET



HOW would you like to be the radio operator on a battleship, receiving confidential code messages and transmitting battle orders?

The job is a thrilling one but you couldn't hold it down unless you had 60 hands and 30 pairs of ears. It takes 30 operators to stand watch on a battlegun and the whole radio department comprises more than 100 men.

Down in the "radio central" below the armored deck there may be a dozen men guarding a multitude of circuits. They listen in on SOS frequencies, ship-to-ship phone circuits, and aircraft and tactical wavelengths. One man stands watch on a wavelength Washington may use. Another radioman is on the bridge. He listens in on tactical messages and relays them by word of mouth to the officers, valuable seconds before the same messages, typewritten, come up from radio central by pneumatic tube.

Communication is vital in warfare and yet the messages must be withheld from the enemy. All communication is by flag or searchlight blinker when ships are within visual range. Radio silence

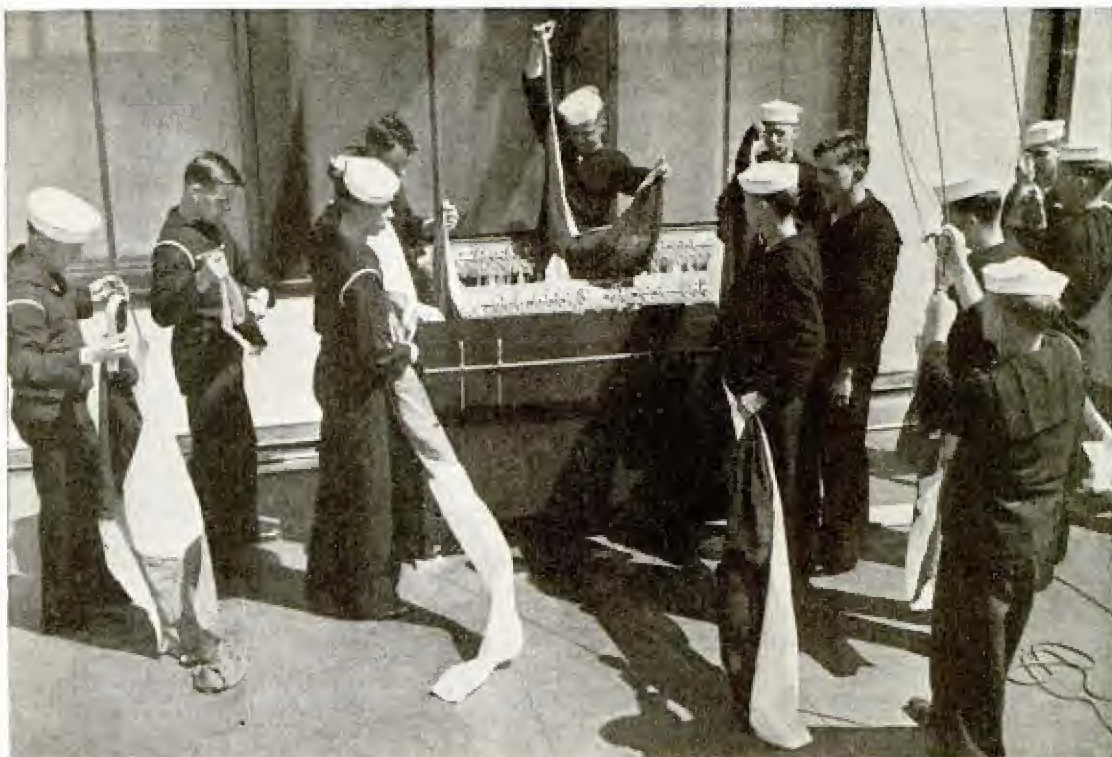


↑ At a naval training station a radio student learns to use the "walkie-talkie" he may carry in small boat landings

← Radiomen are also expert wigwaggers. Most ship-to-ship signaling is by flag or light when ships are in visual range

Below, trainees study wiring of a warship's transmission panel. They must be able to service as well as operate it





is preserved practically at all times and no ship gives away its position even by a short acknowledgment when a message is broadcast to it.

Today the navy's radiomen are as important in fighting a battle as the men who point and fire the big guns. Operators are needed by the thousands.

Communication is only one of the jobs of the sea-going brasspounders. Among their duties are the maintenance and operation of new secret devices. Without

(Continued to page 165)

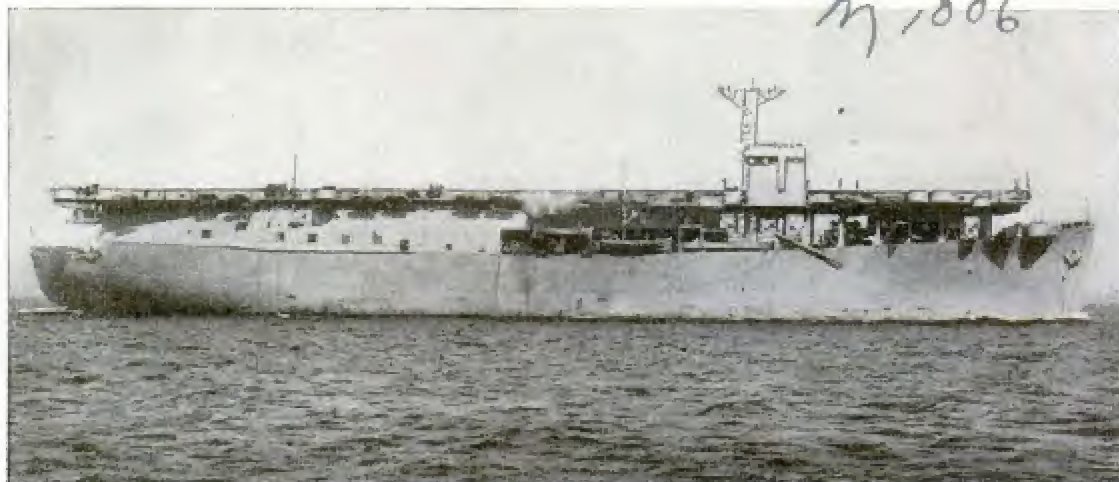
The "ears" of the fleet are also eyes. Radio operators handle visual signals as well as audible; here they are handling message flags in and out of the flag locker



†
An instructor explains the operation of the radio direction finder. This equipment is far simpler than the complicated direction finders actually used on a war vessel

Learning to send and receive code is the easy half of it. The naval students must also become expert at building up the radio sets and repairing them speedily in emergencies

Mr. W. Whitaker
Converted Carrier Serves as a Rescue Vessel



Inspecting and packing parachutes in an air-conditioned room on the Charger is one of scores of duties on this floating airfield. Ship departments include navigation, gunnery, engineering, construction, medical, supply and the all-important air division. Services provided for men range from surgery room to a modern soda fountain

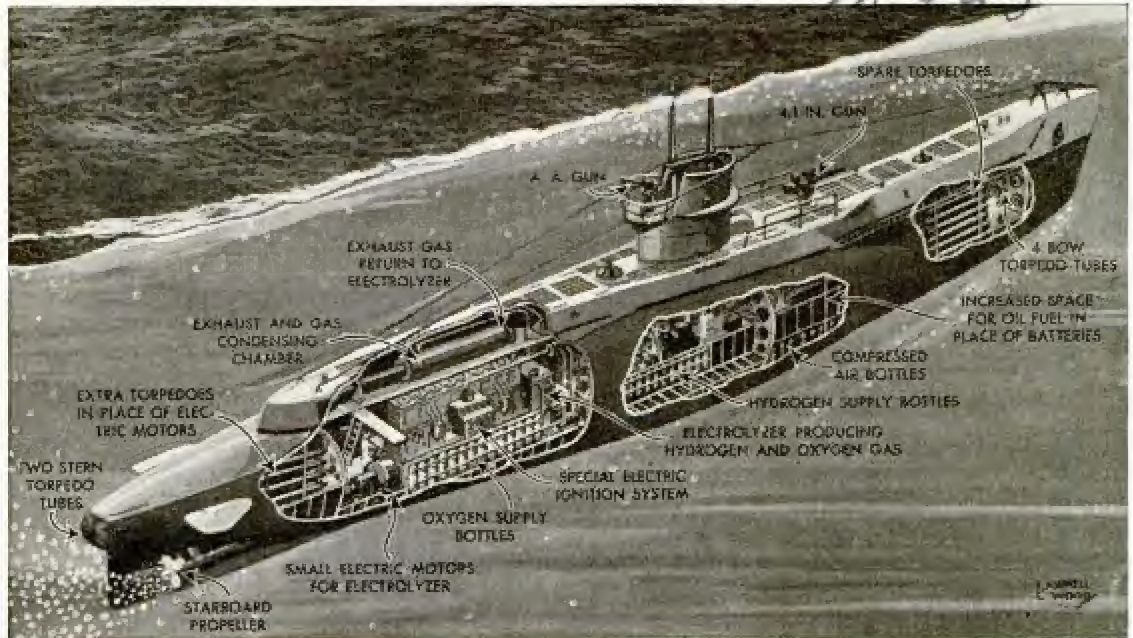
The converted aircraft carrier, the U.S.S. Charger, above, was once a freighter shuttling cargo on a routine run. It now plays a dramatic role with the fleet, rescuing men and planes, perhaps serving on convoy duty. Anti-aircraft weapons bristle along its decks which boast full complement of three-inch guns



Haisting seaplane aboard converted carrier with derrick, above, in rehearsal to retrieve craft catapulted from battleship or cruiser. Planes projected by catapult from freighters in convoy could also be rescued in this way. Left, a signal officer on the flight deck of the Charger signals pilot: "Prepare to land"



London Electatype Agency, 134 7 West St. London, England Hydrogen Engine Replaces Battery in U-Boat



Artist's sketch with various parts of sub labeled indicates revolutionary changes in German boats

Capture of a German U-boat has revealed one of the secrets of their improved maneuverability—a hydrogen-oxygen engine that operates submerged. This eliminates the heavy electric motors and batteries that account for about one-sixth of a submarine's weight. The single, modified Diesel engine burns oil on the surface and a mixture of hydrogen and oxygen for underwater running. Ordinarily, submarines use oil-burning Diesels on the surface and electric motors under water. The reduc-

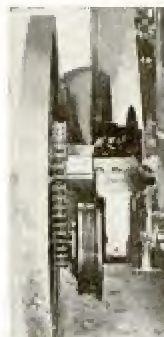
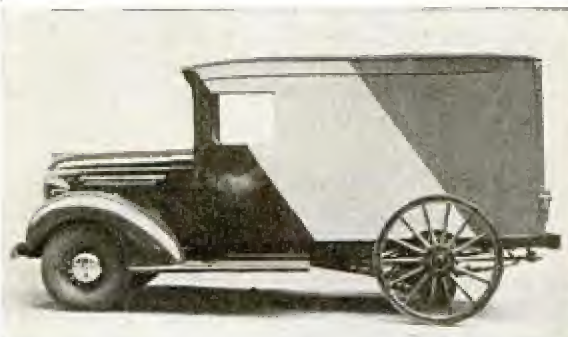
tion of tonnage affords greater speed for crash diving, increases the torpedo load and extends cruising range. Due to its sturdy construction, the sub can submerge to nearly 600 feet—about 300 feet beyond the reach of depth charges. It has smaller tubes than former undersea craft, allowing the use of a standardized torpedo also made for motor torpedo boats and planes. Another feature is retractable deck guns which enable the subs to open fire a few moments after surfacing.

Wagon Wheels on Delivery Truck Save Rubber Tires

As a start in eliminating the use of rubber tires on their delivery trucks, a Chicago newspaper has removed the rear auto wheels and replaced them with wagon wheels having wooden spokes and iron

rims. These trucks, operating in the downtown district, are equipped with governors that prevent speeds greater than 11 miles an hour. The rear axle is left intact, the wooden wheels being borne by an extra

axle which is driven by a chain operating between sprockets on the original and the special axle. Eventually the front wheels of the trucks also will be replaced by similar wagon wheels.



Rear wagon wheels are mounted and driven as shown by the view at right

■ A shot from a 16-inch gun returns 120 pounds of nitrogen back into the air from which it came.

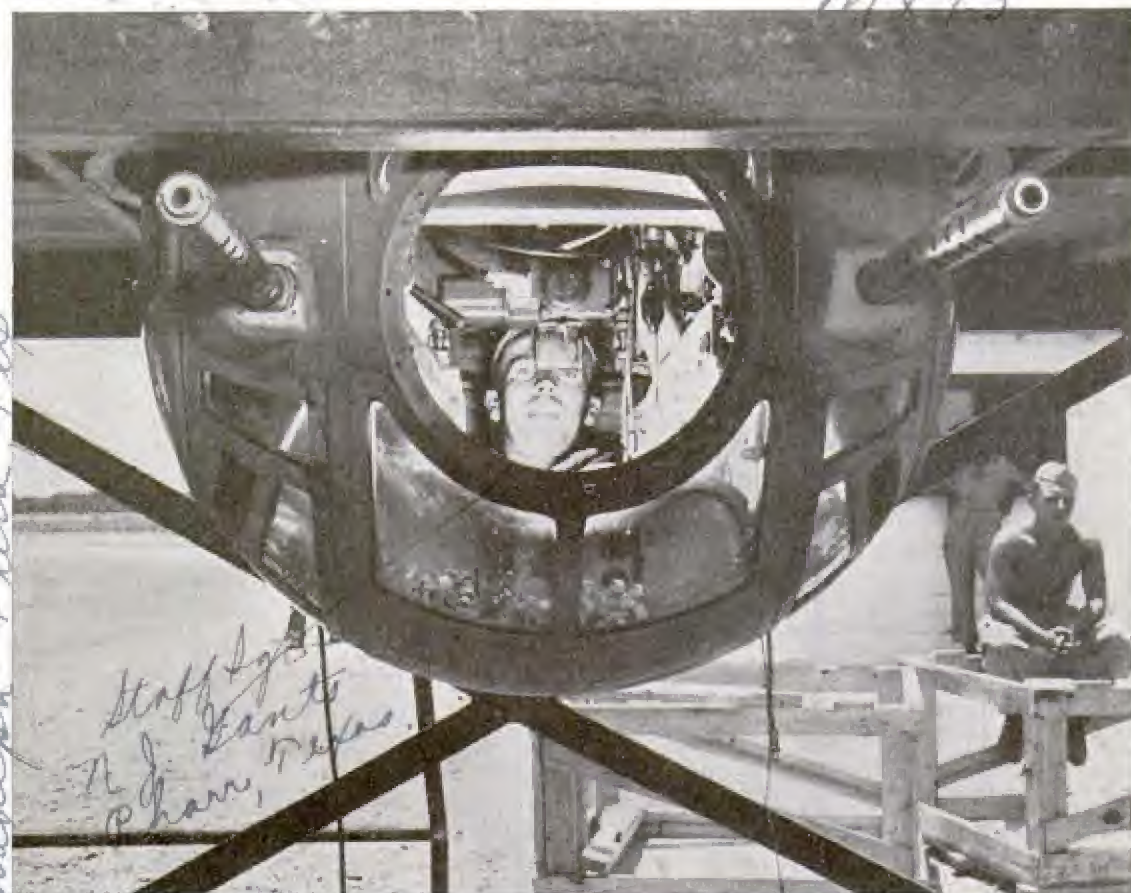
JANUARY, 1943

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Int'l News Photos Inc.
235 - E 45th St., N.Y.C.

Chief of Army Air Force Training Center
Randolph Field, Tex.

Bomber "Equalizer" Spurs Twin Death-Threat



Twin machine guns pointing from bomber's "Equalizer" write the finish of fighters coming too close

So they will be more than a match for the Axis fighters, aerial gunners of the U. S. Army Air Corps, training at an Army gunnery school in Texas, learn every known trick of attack and defense. Snug in one of

the death-dealing aerial gun turrets, which is given the pet name of "Equalizer," a gunner at the school shows what his position will be on one of the big planes as he fights his foe with twin machine guns.

117-Seat Bus Has Pivoting "Nose" Driven From Trailer

One hundred and seventeen passengers are carried in a bus of revolutionary design with the motor in a four-wheel tractor on

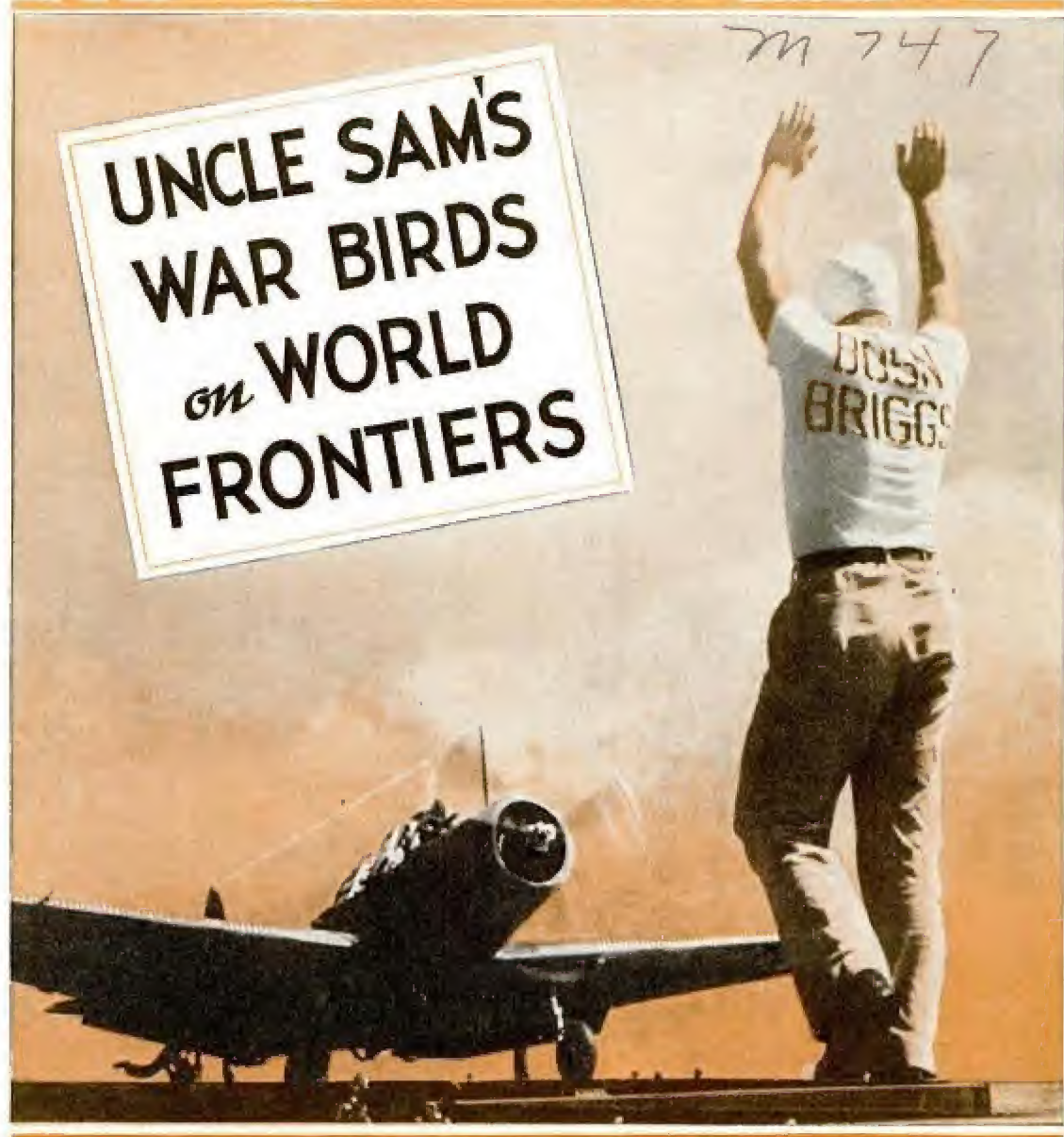
the front. The tractor, which operates on a pivot enabling sharp turns, comprises the lower front unit of the bus and is locked to the body with a device that assures instantaneous control. The driver operates the tractor from within the passenger compartment. Designed as a war emergency vehicle, the tractor-trailer bus is made mostly of wood in order to conserve critical materials. Ten tires are used on the bus, and it can carry more passengers per tire than the average highway "liner."



Pivoted tractor under front of big bus makes sharp turns possible

18 Des. by Gene Allen, Genl. Mgr., Santa Fe Trailways, Eastern Lines (adv. agency - J. M. Farrell, 111 W. Monroe, Chicago) POPULAR MECHANICS

Thomas E. Stinson Jr. 3872 Franklin
Cont! Ave. Los Angeles, Calif



U. S. Navy photo

The boss's mate signals a navy dive bomber to prepare for the takeoff from the flight deck of a carrier

EAST or west from the United States, it is less than 24 hours by air to the battlefronts of this world-wide war. In some cases airplanes that left our shores one day have taken part in raids against the enemy on the next.

Wherever they meet the enemy—and there is hardly a neutral area left in the world—Yankee pilots and planes are taking their opponents by surprise. Twenty-

seven Jap "Zero" fighters thought they had an easy job when they sighted one American "Flying Fortress" north of Australia early last year. But every Jap that attacked the bomber ran into a stream of bullets. Twelve of the Japs were shot down before the rest quit. The bomber flew on.

The saga of the Flying Tigers is another story of what Americans are doing. This American Volunteer Group was battling

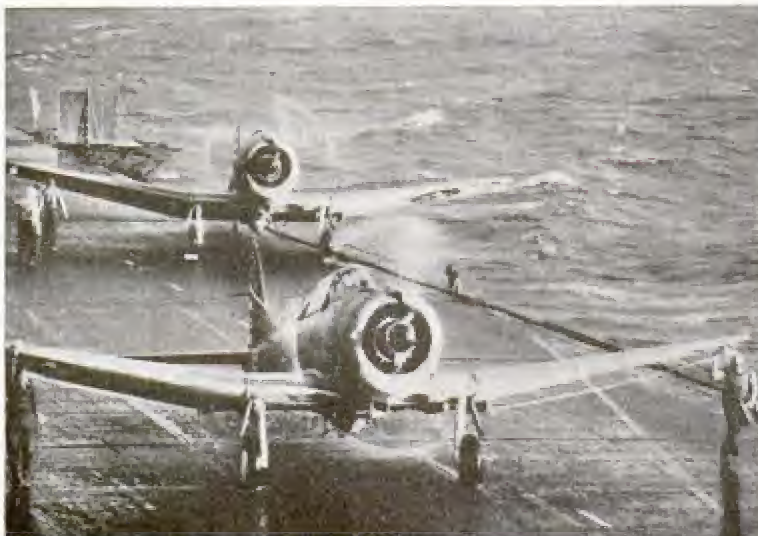


Douglas medium bombers—a type used also by the British—step out across the sky in formation flight

the Japs before the United States entered the war. They flew obsolete P-40 pursuits against enemy aircraft that could outfly and outclimb them, yet by official count they destroyed 34 Jap airplanes for every P-40 shot down, and got 97 Jap pilots for every American lost in combat. On one mission they knocked down 20 Jap bombers long before the bombing target was reached; on another, 18 Flying Tigers knocked down 19 Jap fighters with nothing

in return except a few bullet holes in the wing of one plane. In China and Burma the American volunteers have destroyed 552 enemy planes. Part of the secret of their success is the shrewdness of their commander, Gen. Claire L. Chennault, who taught them the weaknesses of Japanese air fighting tactics. Today the A.V.G. has been inducted into the army air corps and is still in action abroad.

American airplanes are operating over Europe, Asia and Africa. In the factories where 4,000 or more planes per month are being produced, army ground mechanics are being turned into specialists and after graduation are sent to Iceland or Greenland, Australia or India. Thus, no matter to what front contingents of bombers or fighters are to be sent, trained men will be available to service and repair



Loaded with heavy "eggs," dive bombers warm up for the take-off on a deck slippery with rain

The pilot of a P-38 night interceptor arrives just as the fueling of the Lockheed is completed

them. Already the mass delivery of big bombing planes over the oceans has become commonplace. Augmenting the work of the army ground crews is a corps of civilian specialists, factory trained, who advise and instruct the ground forces at the camouflaged front-line fields.

Air operations are on such a vast scale that airborne supply is imperative. The army has expanded its own air transport service to a point where it exceeds by 10 times the operations of all the world's civil air lines before the war. The standard transport is the Douglas C-54, with a weight-carrying capacity of an ordinary box car. Tanks or guns that are too large to get into the cabin can be suspended under the fuselage for aerial delivery. Groups of such planes are capable of moving an entire army division, complete with equipment, across an ocean. Budd Manufac-



Loading spare aircraft parts on a Douglas cargo carrier that will ferry them across the ocean to a U. S. army air base. Below, airport guards stand by Douglas freighter



The bright tube on nose of this navy fighter plane's machine gun conceals powder flashes
U. S. Navy photo



turing Company, for instance, is preparing to produce huge air freighters that are made entirely of stainless steel. Steel airplanes, it is estimated, can be built in half the time now required, and the construction will be as light as aluminum.

"Good old 315," a DC-2 that was retired from transcontinental air line service after two million miles of use in eight years, is representative of a group of veteran transports that might be called the tramp ships of the air. Carrying ammunition and food to desert troops in Libya, evacuating wounded from Iraq, and hopping military personnel across Africa have been some of their duties. They operate day and night out of makeshift fields, lift loads that are over-

Safe back in England, the pilot of a Lockheed Hudson inspects hole torn by antiaircraft shell

As the pilot of a Lockheed P-38 climbs out, a mechanic climbs aboard to check the plane over





At a newly established island base in the South Pacific, navy aircraft mechanics assemble a new seaplane

weight by up to a ton, and keep on going. These veterans aren't worn out yet although many carry the marks of their service. Old 315, for instance, has 200 patches that cover bullet holes she got in a ground-strafting in Iraq, and still has the marks on her port engine cowlings that she received when one mechanic and some native help had to fit a new engine on her after a forced landing brought her down on an African beach. The beach was a good emergency landing field, but it was too soft for a takeoff, so a runway 1,200 feet long was built of bamboo, then covered with packed sand, so the repaired airplane could get into the air.

Meanwhile the do-

mestic air lines have turned many of their passenger transports into cargo carriers to back up the overseas service. These planes are carrying blood plasma and vital military supplies to our bases in the Caribbean and in other areas. Thirty planes in one



A navy ordnance man sets the fuse of a bomb attached to the wing of a big patrol seaplane



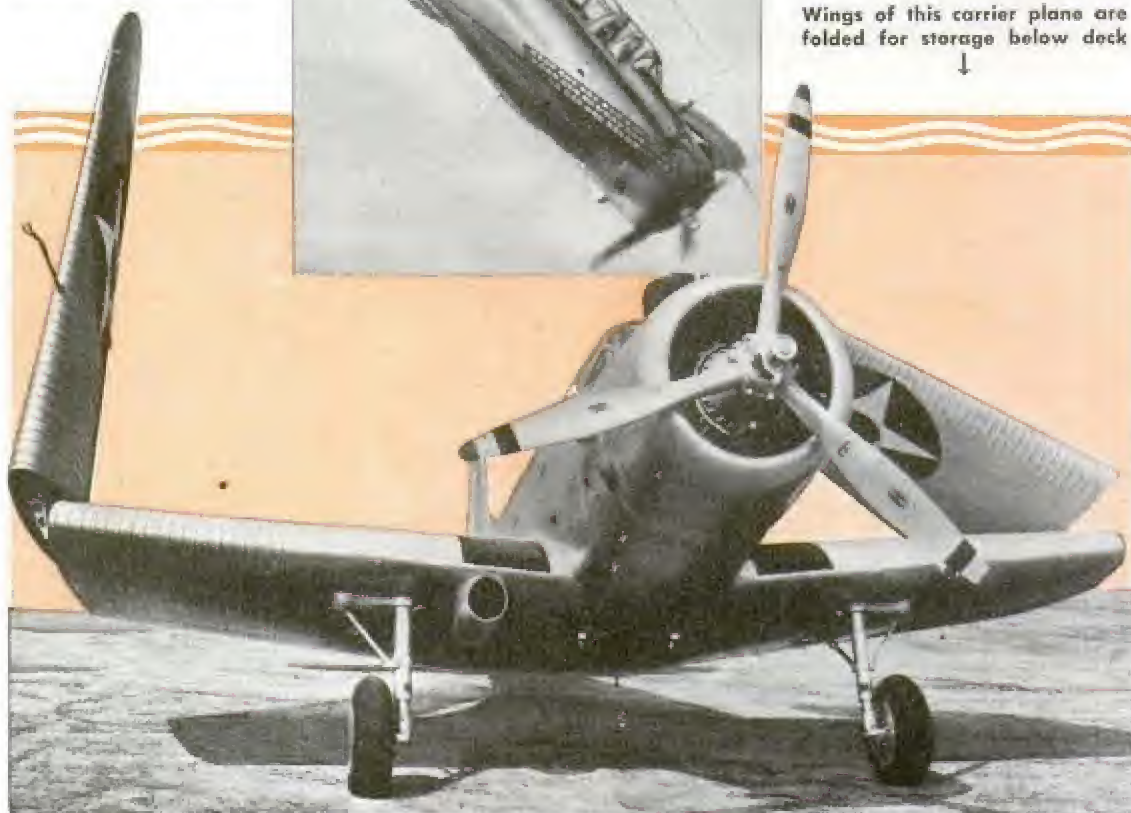
flight recently made a cargo haul to Greenland, then returned for more loads. When an army post in Alaska needed several 10,000-gallon gasoline tanks and some four-ton gasoline trucks, the tanks and trucks were cut into pieces with acetylene torches and loaded aboard the transports, then flown to Alaska where mechanics welded them back together, as good as new.

The new fighting planes that are coming from American production lines are among the best in the world and yet no designs are "frozen" to achieve greater production. Instead, while a better plane is being designed and tested, we erect a new factory to build it. Not until the new assembly line is in production is the older model dropped in other plants.

Wings of this carrier plane are folded for storage below deck
↓

Tail and belly guns point menacingly from the Boeing "Flying Fortress," now in action over Germany and the South Pacific

Pointing straight for its target, right, is a Douglas-built dive bomber of the army air corps. Notice its perforated wing flaps



Thirty-caliber ammunition, the same that is used in a soldier's rifle, was the standard airplane machine-gun bullet when the war began. But one machine gun did little damage, so engineers began to mount as many as eight synchronized machine guns, all firing at once, on fighter planes. The answer to this was protective armor, neutralizing the .30-caliber bullets. Now many types of fighters are equipped with .50-caliber machine guns as well as guns that fire explosive bullets of the 20-millimeter size.

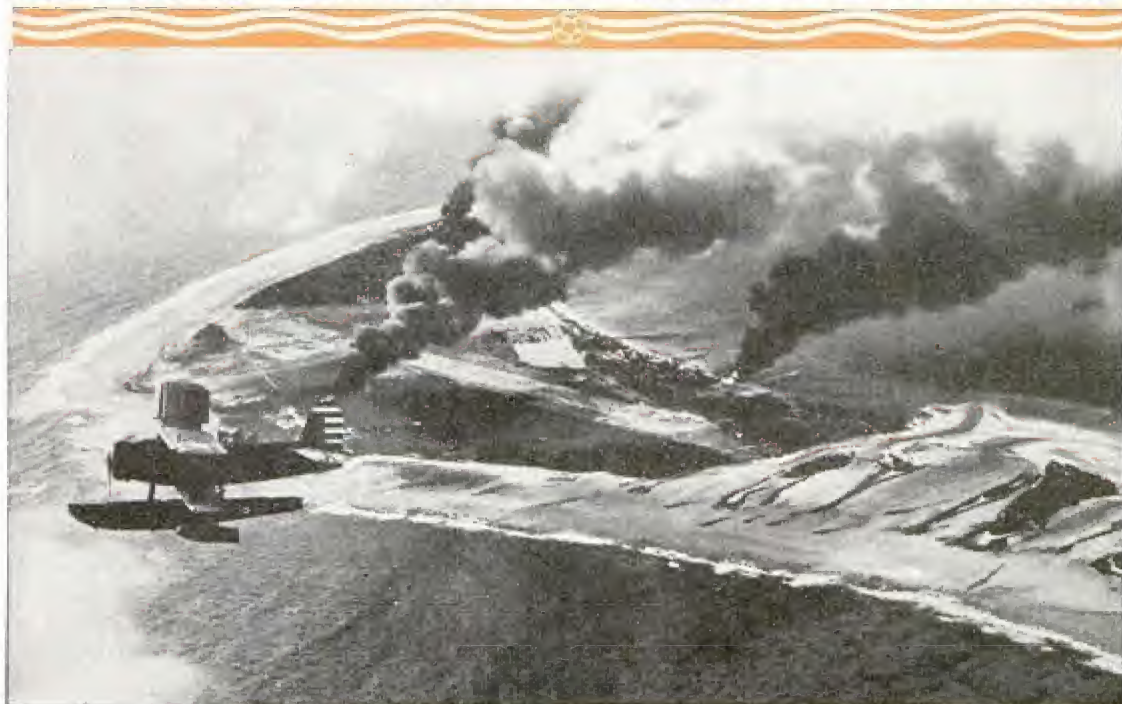
On the other hand, our own bombers are the battleships of the air, and, like battleships, can suffer heavy damage and still carry on. One R.A.F. pilot, who had flown an American bomber on a raid over Germany, reported: "Explosive bullets ripped past the armor plating of the gunner's cockpit. The starboard engine was holed in eight or nine places but didn't even cough. The port aileron cable was shot away and the tail

badly damaged. The starboard outer tank was pierced by bullets but the self-sealing apparatus worked immediately." After bringing this plane home safely the same pilot, five days later, was over Calais in another raid. This time a heavy anti-aircraft shell burst below his Douglas, splinters of the shell hitting both engines, both



Members of crew train in altitude chamber before flying at high altitude

Navy scout flies over Jap island base during bombardment in which ships and shore installations were destroyed





The "mother" ship with its brood of planes on deck, lined up for the takeoff, is photographed from a plane that has just left the deck. Below, troops laden with full equipment for action climb into cabin of one of the new Douglas troop carriers



flaps, and the rudder controls. A piece of shell the size of an egg tore its way through the radio apparatus. In all the plane received 20 hits. The rudder was useless but in spite of this the pilot again brought his plane home, using the engines for control. Bomber crews are wearing steel helmets today, to protect themselves from possible injury from antiaircraft shells that may burst above the planes.

The Lockheed Hudson is another bomber that has proved it can complete its mission in spite of battle damage. They serve as reconnaissance planes, in sub hunting, and have even been used in dog fights as well as for bombardment. Hudsons have returned with the nose shot away, a wing tip and aileron torn off, or with an engine and propeller missing.

Americans, British, Germans and Japs have all learned that the airplane is the supreme weapon in this war. Today, with production lines and training in high gear, the United States is rapidly becoming supreme in the air.

2202 W. 3rd St.
Los Angeles, Calif.

Emergency Gas Mask Is Pad of Baking Soda

m 950

Ref: If standard gas masks are unavailable in a war-threatened area, a home-made mask proposed by Dr. Kearney Sauer, gas authority for the Los Angeles civilian defense corps may serve in an emergency. The mask is made from a piece of bed sheeting and baking soda which will protect the eyes and lungs against all known war gases, including mustard and lewisite. Cut a piece of cloth to 12 by 24 inches and sprinkle the baking soda a quarter inch thick over one-half of its surface. Then fold the other end over the baking soda and pin the edges to prevent the soda from spilling. Next, with



Four steps in making emergency gas mask. Inset shows how it is used

pins, quilt the pad into numerous pockets to hold the soda in place. To finish the mask, sew the edges together with thread and sew along all the quilting lines, after which the pins may be removed. When it is to be used the mask should be soaked in water to wet the baking soda. Then hold it tightly against the face, keeping the eyes, nose and mouth covered, and inhaling and exhaling through the wet soda. Since the

soda becomes contaminated when used against gas, a mask should not be used more than once. Usually a mask is good for upwards of half an hour of actual use, within which time even a heavy concentration of gas would be dissipated. A bottle of water should be kept where the masks are stored. The soda is not effective against carbon monoxide or ammonia fumes, but these are not used in warfare.

Tandem Run by Washer Engine Does 25 Miles an Hour



Work of pedaling this homemade tandem is taken over by washing-machine engine using little gasoline

Actual or threatened rationing of gasoline, tires and bicycles does not bother George Vassen, of Quincy, Ill., who has solved his transportation problem by constructing a tandem bicycle powered by a discarded washing-machine engine. Salvaging two cast-off bicycle frames, he fashioned them into a tandem with the aid of hacksaw, welding torch and pipe cutters. After adding handlebars, saddles and tires, and mounting the small engine, the builder found his new vehicle can carry himself and one passenger at 25 miles an hour, doing 50 miles on a gallon of gasoline.

ⒸAn infantry division in 1918 was equipped with machines of 3,300 horsepower; today's armored division totals 400,000 horsepower.

Paul Garrett, V. P. 27
General Motors

for National Cash Register Co. 1150
Rockefeller Plaza, New York

MAPS FOR THE AIR AGE



By Wayne Whittaker

IT'S the airplane and not the Nazi blitz of boundary lines that has map-makers worried.

When the Wright brothers made the first flight that historic day at Kitty Hawk they discovered a new world just as Columbus did in 1492. And the map-makers are too busy charting that new world of air distances to bother about European boundaries smashed by one Adolph Schicklgruber. As far as they are concerned, Hitler hasn't altered a boundary.

The official map-makers recognize a change of boundary only when it is fixed by treaty. Since the beginning of World War II, just three have been changed: boundaries between Finland and Russia, Ecuador and Peru, Indo-China and Thailand. The makers of military maps, however, follow the blitz of boundaries in each fresh edition of the newspapers.

It's a jolt to think of the world in terms of airplane instead of flat land routes—a world where distances are measured across

The giant map above, one of the world's largest, was two years in the making. It is 15 feet four inches high and 32 feet six inches wide. Below, cutting hole in plate to change a boundary



Courtesy Rand McNally & Company

continents and oceans alike without regard to mountains, deserts or arctic wastes. Such a world is shown on a new map that looks like a wheel with the North Pole for a hub. It is designed for the air age.

At first the map gives you a dizzy feeling—like being on a perch on the North Star directly above the pole looking down at the earth with the southern hemisphere

11-8 as - nyc - Miss Cousin



conveniently raised into view. You pick up a piece of string to prove that this strange map world is badly out of joint.

One end of the string is held on Tokyo, the other on the Panama Canal. This shows the shortest route for a squadron of bombers between these points is over the Aleutian Islands and the western part of the United States. Checking this with the globe, you find that the straight line on the new map nearly coincides with the great circle route—the shortest distance between two points on the earth's surface—from Panama to Tokyo.

The map also shows that the Maine coast is the closest point in the United States to Africa; that the shortest route from Seattle to Moscow passes near the North Pole, and that bombers from Berlin can strike at the steel mills of Gary, Ind., almost as easily as they can attack the east coast by flying over Iceland and Greenland. The string measurements reveal that this flat map may be used like a globe.

The pole-centered arrangement on the map calls for a new conception of the earth—just like an original camera angle gives a new slant on a familiar

Polar projection map, above, is made like a wheel with North Pole in center. Black lines trace present routes of heavy air travel. Below, spraying a globe after it has been mounted to give it lustrous, waterproof surface





Photographing a map drawing with huge camera which makes negative on plate glass the exact size the printed map is to be



The center of interest for world travelers at the Pan American terminal in Miami is the mammoth globe, above. Below, hand-mounting a globe by pasting on individual "gores" that are printed in flat sheets and then cut out to make perfect fit



homestead. The concept of the world with the North Pole in the center and continents radiating from it is as strange to us as were the maps of the New World to Europeans after Columbus discovered America.

Looking down at the air-age map from the North Pole, you see that 75 percent of the land areas are north of the equator and that the pole forms a hub for direct aeronautical routes between the great population centers of the earth. The future importance of polar routes was stressed by the late Brig. Gen. William Mitchell in 1935 when he said:

"Whoever holds Alaska will hold the world. Alaska is the most central place in the world of aircraft."

Lindbergh, too, knew he was flying across the center of future air travel when he flew north to the Orient. Russian fliers blazed a trail when they flew across the Arctic from Moscow to California. In the postwar world huge stratosphere planes will shuttle across the arctic region carrying passengers and freight much as commercial planes travel today between New York and California.

The airplane pilot finds cold air 20,000 or 30,000 feet above the earth. It is little if any colder over the pole at this height than it is over Chicago or Omaha. Air explorers report that the weather is more constant over the Arctic area and the air calmer than it is over the temperate zones.

The Arctic Sea has been called the "Mediterranean of the Air Age," harking back to 1000 B.C. when the routes of sailing vessels criss-crossed the Mediterranean and the world was thought of as a flat disk with that sea in the center.

Development of large ocean-going sailing boats and then fast power-driven ships called for new conceptions of the earth, just as air routes do today. Down through history the making of maps has been spurred by inventions—rowboat, sailboat, steamboat,

train, airplane—by wars, the search for gold, fur and jewels. Great explorers like Marco Polo, Magellan, Drake, Bering, Livingstone, Amundsen, Byrd and scores of others have kept the cartographers busy.

Ever since the world was discovered to be spherical in shape, the big job for the map-makers has been to chart it on a flat surface with a minimum of distortion. This is accomplished by what is called a "projection," or grid of lines representing latitude and longitude.

One of the most widely used projections was devised by a Dutchman named Mercator in 1569. Airplanes make the Mercator projection outdated because it gives a conception of the world as a cylinder. Bring the ends of a flat map together and you have the cylinder. Today the airplane makes it impossible to regard the North Pole as the top of the map and the South



Preparing the grained surface of thin sheet of zinc for offset printing of map by coating it with a sensitizing solution

Pole as the bottom. The airplane places the North Pole at the center like the hub of a wheel with the meridians forming the spokes.

The cartographers had to find a polar projection for the air age. They discovered

The air-age map which revolutionizes man's conception of the earth is marked with airplane routes. Direct bomber route from Tokyo to the Panama Canal is via Dutch Harbor and Salt Lake City





Geographical expert at work on the world's largest curvature relief model of the U. S. at Babson Institute. Below, view of the Great Lakes on model, looking down from Ontario, Canada



the projection was all worked out for them back in 1581 by a man named Postel. Helmut Bay, assistant chief cartographer for Rand McNally & Company, says that prior to 1930 he had seen only two maps made from the polar projection which is the basis for the new air-minded map. Every point on this map is shown at its exact distance from the pole.

"As long as the world was conceived as a cylinder, there was no great interest in the Arctic region," said Mr. Bay. "Air travel has changed this, and today airplane geography requires a map of three dimensions with the North Pole in the center."

The new Rand McNally map, edited by Dr. George T. Renner of Columbia University, has little distortion in the continents of the northern hemisphere. The east-west

distortion south of the equator, which gives the map its unusual appearance, is caused by the continued divergence of meridians when they actually converge toward the South Pole on the globe.

Germany, Japan and Russia are ahead of the United States in teaching their people an air concept of the world, according to David E. Sites, the noted geographer. Polar maps, now being introduced in American schools, have been used in the institutions of those nations for several years.

Japanese students were not surprised—as were many American adults—that the Aleutian Islands are on the direct bomber route to America. Youthful Nazis have been taught that the Luftwaffe can fly over the rim of the Arctic Circle to strike at the industrial Middle West.

The strategic value of Iceland and Greenland cannot be overlooked on the new map—no longer are they vague areas somewhere north of the travel routes. The nearest point in Occupied Europe to the United States is the northern tip of Norway. This is a distance of only 3,100 miles from the

(Continued to page 162)

Measuring great circle routes on a new "free turning" globe with hinged blades on either side. Air routes follow curve



Home Newsclippers Inc
461 - 8 av. nyc.

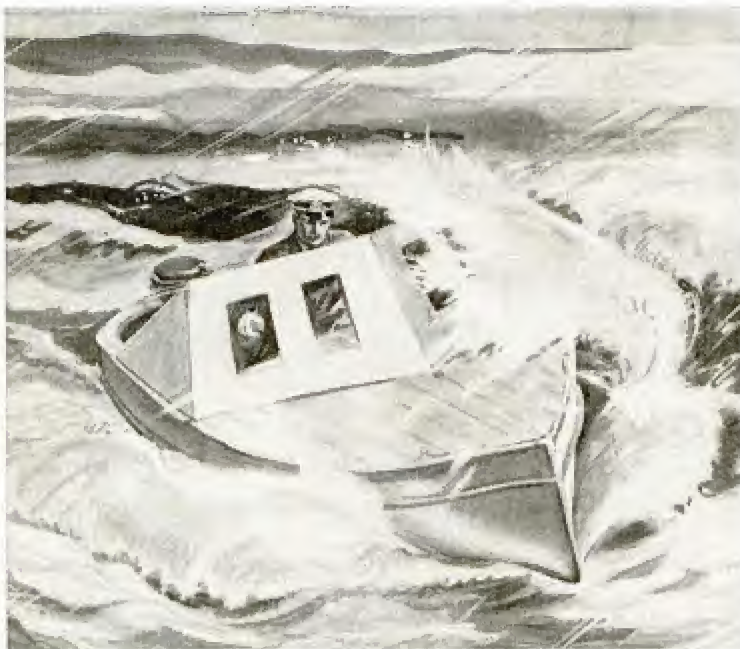
Jeep Flies Target Plane to Help Gunner's Aim

In one stage of their ground training, aerial gunners of the U.S. Army Air Corps practice firing machine guns at a dummy plane mounted high above a jeep. Driverless so no one will get hurt, the jeep runs around a track to simulate a plane in flight. Aerial gunners start by shooting clay pigeons with shotgun shells and follow a rigid course of study and practice to become crack marksmen.

Ground training for aerial gunners includes firing at airplane towed by jeep on range



Folding Spray Shield for Boats Has Windows of Plastic



Protection from spray and wind is afforded, as well as good visibility, by a fabric shield for small boats. The shield, which has four windows made of plastic that will not blur with age, is supported by collapsible telescopic posts attached to the craft with small anchor plates. Two thumbscrews hold the shield taut. When not in use it can be stored in a canvas bag.

Pilots of small boats avoid a soaking in stormy weather with shield that is carried in small bag when not in use

Color Film for Home Developing Will Be Ready for Post-War Market

Color film that can be developed in the amateur's home darkroom is ready for the market when war needs and priorities are a thing of the past. The new film was announced by Agfa Ansco, which has been working with the process for four years. Another new product promised by Agfa-Ansco for the post-war market is a sound-

track film which will permit the continuous playing of a phonograph without changing records or using a needle. This sound film, named "Ozaphone," will cost much less than the silver type sound films and thus bring sound recording within the financial and technical means of the amateur photographer.

"HEAR YE! HEAR YE!" ⁷¹⁵³⁴ or DO YE?



to fight each other. If one thought of ear trouble in relation to battle, it would be considered inevitable that gun crews would have their hearing impaired by the crashing explosions of gun charges and that soldiers and sailors would have their eardrums shattered by shell blasts.

This war, experts are warning, will be different. We are all "in up to our ears." Most people who live in localities likely to be subjected to air raids have probably planned exactly what they would do to save life and limb should bombs fall. Few, however, have given any thought to the danger threatening their ear mechanism which is assembled with incredible delicacy for efficient operation.

How delicate? Well, Walter Mikelson, General Electric Com-

Of the first 2,000,000 examined for the draft, 41,000 were rejected for defective hearing; 50% hearing ability is required

When a turbine gets into trouble it usually "sounds off." Here a General Electric engineer listens in with sound-level meter

THERE are scientists who seriously believe nature would have been wiser if she had attached the human ears somewhere else on the head, perhaps in front of the temples or on the forehead, where they would have been very conspicuous so that we might pay more attention to them and give more thought to our hearing, as we do to our sight.

There is also a growing belief that since man's hearing is getting more and more defective with the pounding of civilization's noises, and hearing aids are getting more and more efficient, our great grandchildren may be wearing these little devices in and behind their ears as commonly as we now wear glasses.

Especially if wars continue to sweep the world. War is probably the greatest enemy that ever assailed mankind's hearing machinery and medical specialists are sounding quiet alarms that probably will become a clamor a year or so from now. In past centuries, nations dressed up a part of the male population in uniforms, trained them as soldiers and sailors and sent them out



Submerging my



Sonotone Corporation



When friends tell you not to talk so loud, you're getting deaf; lights of meter (left) indicate volume of voice in decibels. Right, if you hear watch tick much louder through teeth than ear, your ears are in trouble

pany sound engineer, estimates that the power involved in the sound waves necessary for hearing is so small that the total energies radiated by the adult population of the nation speaking in a normal tone of voice would light only one light bulb. The audible frequency range extends from 30 to 18,000 cycles per second and the intensity range varies upward from 0 to 120 decibels, a ratio of 1,000,000,000,000 to 1. If you will consider the ear as a scale, you may envision it accurately weighing a pin one instant and a battleship the next.

If you want such a fragile arrangement of bone, tissue, liquid and nerves to go unharmed through a bombing raid, it would be wise to prepare some waxed cotton ear plugs in advance. Or buy a number of the detachable red rubber pencil erasers with two flat surfaces which are still obtainable in many variety or stationery stores and which make good plugs.

Lacking these at the critical

Museum model of ear sways back and forth demonstrating ear is seat of body balance

moment, it will help to cover the ears tightly with the palms, keeping your mouth shut. If you can't shield your ears in this manner, by all means keep your mouth open while bombs are falling nearby and swallow rapidly and repeatedly. Yawning would help, too, but it is pretty hard to yawn during an air raid.

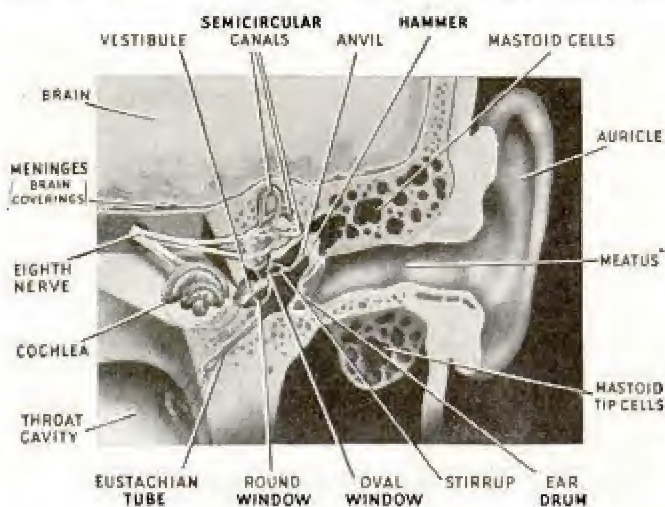
Nature has provided an air vent leading



Walter Mikelson



Portable sound-level meter built by General Electric engineers tests the noise of airplane propeller and engine in cockpit



Here is the highly complicated mechanism of hearing. Sound vibrates the drum, and movements of hammer, anvil and stirrup transmit sound to nerves reaching brain. Below, using two soundproof rooms to make an accurate test of subject's hearing



from the back of the throat to the enclosed space behind the ear drum in the form of the eustachian tube, which remains shut until you swallow or yawn. To illustrate its action, place your thumb tightly against your forefinger. Now bend both thumb and forefinger and notice the aperture. A similar aperture is created at the throat end of the tube as you swallow, and it may save your ears by counteracting pressure changes—if you keep your mouth open when a bomb explodes.

Strangely enough, most of the ear damage is not done by the initial concussion, but by the vacuum which follows in which the air is so rarefied that, in England, many cases have been recorded in which the ear drums were not only shattered, but the three bones which conduct sound were pulled out of each side of the head.

However, Dean Babbitt, president of the Sonotone Corporation and a noted authority on hearing, says that actually the air-raid menace to the nation's hearing is more spectacular than important in relation to the total effect.

"For every person thus rendered deaf," he says, "there will probably be thousands who will have their hearing impaired by other wartime causes unless they take precautions.

"Bomb casualties are special cases, like deafness which comes to members of gun crews even though they are trained to plug their ears and turn their heads when firing. Or to aviators, and especially dive bomber pilots, whose ears are affected by sudden changes in atmospheric pressure as well as motor and propeller din common to warplanes. Far more dangerous to the average civilian in wartime is the effect of disease, and the records of World War I prove it."

A great proportion of the ear ailments which are estimated to have seriously impaired the hearing of 17,000,000 Americans at this time can be traced to the epidem-

*Sonstone Corp.,
1944 at NYC.*

ics of common cold, influenza, pneumonia and skin rashes which are given an opportunity to spread when war disrupts the sanitary and health maintenance facilities of a community.

Of the first two million called for the current war draft, men who were children and youths during the last war, more than 41,000 were rejected because they could not pass the "whisper test" in which an examiner stands 20 feet behind them in a moderately quiet room and calls in a low tone numbers which the draftee repeats. If the draftee cannot hear the whispered words at 20 feet, the examiner moves closer and closer until the man does hear. If he can hear at 10 feet—that is, if his hearing is 50 percent—he is acceptable for service. The ominous angle is that these two million men were the choice specimens of the nation from the standpoint of ear health, which usually begins to deteriorate around the age of 25.

Authorities on hearing warn against neglect of infections of the nose and throat.

Such infections can easily reach the middle ear through the eustachian tube and travel to the inner ear. The pus of a middle ear infection, if not properly drained, may spread to the mastoid whence it is eliminated only with difficulty. A chronically running ear brings destruction to both bone and other tissues. Often, during a cold, the lining of the eustachian tube becomes swollen and inflamed. If the swelling lasts a long time, a condition is created favoring bacterial growth in the middle ear. All this makes it clear why colds are such a danger to hearing.

Expert advice is: Take a rest and the usual precautions advised generally by physicians. Be wary of self-medication, especially of washing out your own nose. Too strong gargles and washes will ir-

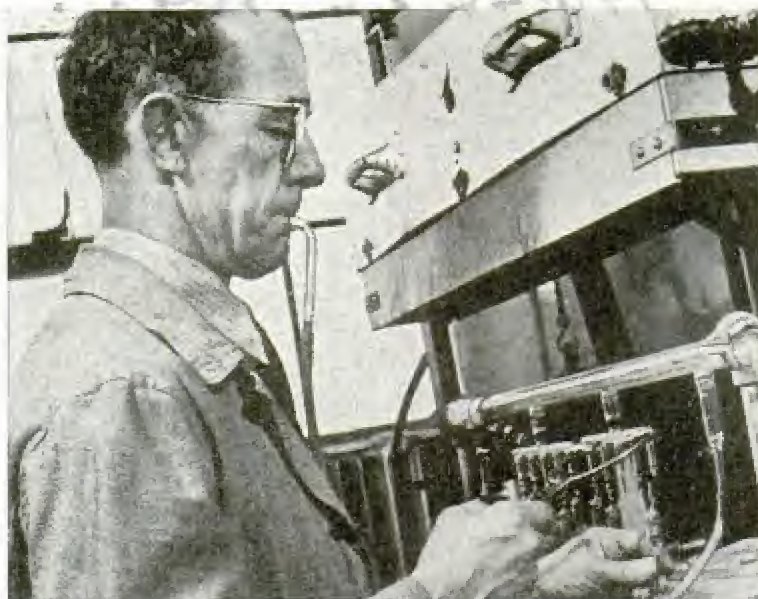


Listening with the "magic trumpet" to a broadcast of music or voices sent out by means of magnetic waves

Heart of an important hearing aid is the midget vacuum tube, which uses a battery to magnify sound waves

Scratching one end of a ruler held against the ear bone, then away from it, is one test for deafness





Exhausting air from one of the hearing-aid vacuum tubes by lung power

ritate the tissues. Sprays and douches are dangerous in that they may force germ-laden mucus into the middle ear. Blow the nose properly with head upright or tilted slightly forward and use just enough pressure to clear one nostril at a time. Violent blowing is likely to force infected material

ometer, will not only determine the efficiency of your hearing apparatus, but if impairment exists, it will indicate, by a comparison of bone and air conduction curves, whether the impairment is probably due primarily to middle, or inner ear trouble.

Pointing the light gun at any of the objects on the board causes sounding of the pitch which is associated with the object



into the eustachian tube and middle ear. Consult a physician on any infection which affects the ears. Remember, a doctor can treat himself for many ills, and some have even operated on themselves, but when a doctor gets ear trouble he invariably goes to another doctor.

On the brighter side of the picture is the increasing number of ear specialists, or otologists, who are taking advantage of what science has developed, particularly in the line of testing machines.

One of these, the audi-

There are dozens of thumb-rule methods of testing hearing, as well as many machines. Some of the latter mechanisms have been speeded toward development by experiments in listening gadgets and sound meters which corporations like Western Electric, Westinghouse and General Electric have developed to listen to the tones set up by a mechanical device in motion. It appears, in general, that a healthy machine purrs and an ailing one whimpers, groans and moans, somewhat like an animal. Experts get to know the symptoms.

The development of improved hearing aids, based on the use of special five-element midget vacuum tubes which amplify sound impulses, has restored to an efficient level the hearing of tens of thousands of Americans.

Also encouraging is the attitude large corporations have taken with regard to noise reduction. Sound-proofing devices, ear plugs and even hoods which not only deaden



If you can insert one fingertip deeper into jaw juncture than the other when the jaw is down, ear trouble is likely on other side

Automatic hammer (right) sets tuning fork vibrating visibly under stroboscopic light, demonstrating how vibration produces sound



din, but keep foreign particles out of the ears, are being added steadily to factory equipment. "Boiler-maker's deafness," a common occupation trouble a couple of decades ago, is not so often heard of today.

Says Sound Engineer Mikelson: "The attempt to reduce unwanted noise in our mechanized civilization is well founded. Nature provided the eye with the iris with which it can adjust its aperture to accommodate various amounts of light. Nature also provided an eyelid which can shut out light altogether.

"It is unfortunate nature did not provide the ear with a lid or control mechanism with which it might protect itself from strong sounds. There is probably a good reason for this, since the ear can withstand the loudest sounds nature has to offer, thunder, the hurricane, and the pounding of angry seas. At the time nature developed the ear there was no need for additional protection. Perhaps the ear too will evolve a protective mechanism

against man-made noises. Whistles and horns at close range, riveters, and boiler shops have a damaging effect."

It is best to leave the ears alone, particularly avoiding the insertion of fingers and foreign objects, except sterile plugs for special reasons. You might heed the ancient wisdom of the Chinese, who have a clever phrase for it: "If you must scratch your ears, use your elbows."



Youngsters listen with rapt attention to music amplified from phonograph by a group hearing aid

Some Newspaper pictures on 2161-800, NYC.

Ship Ventilators in 'Parking Lot' Await Welder's Torch



Ventilators get visit from welder who applies needed reinforcement

Parked en masse in an outdoor clearing, cowl ventilators produced by the thousands at a west coast plant are inspected and reinforced by a strolling welder. The workman carries fuel tanks on a two-wheeled cart. Mounted on upper decks, these ventilators send fresh air into the enclosed portions of the hulls of Liberty ships.

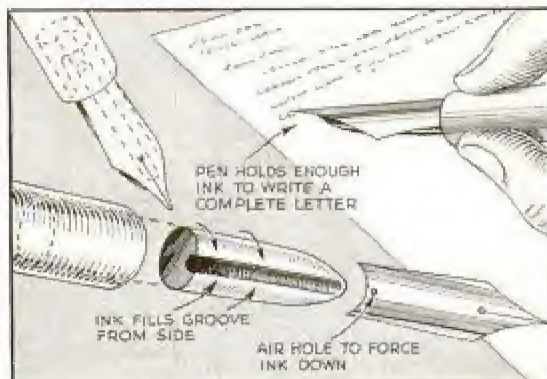
Bombs Aid in Pheasant Census By Making Male Birds Crow

Taking the census of pheasants has been hastened and simplified by Dr. Elliott McClure of Ord, Neb., who sets off "dago bombs"—the kind used to enliven fairs and community celebrations—to make the rooster pheasants crow and thus render them easy to count. Bombs are usually ex-

ploded on a hill or other high place so the sound will carry well, and spotters stationed around the hill do the counting. An annual census of the birds is taken in order to arrive at the proper bag limits and length of the season. Previously, game wardens would drive along specified routes, counting the birds along the roadside, and the figures would be multiplied by a factor to get the total number of pheasants in each county. The bombing idea was developed from knowledge that pheasants will crow when it thunders, when there is blasting or when a shotgun is discharged.

'One-Dip' Pen Point Holds Enough Ink For Long Letter

Frequent dipping into the inkwell is unnecessary when writing with a "one-dip" pen having a reservoir that retains sufficient ink for 100 to 150 words. The penholder is of plastic and includes a tiny plug that inserts into the socket to hold the nib in place. A groove in the plug facing the nib serves as an "inkwell" to hold a supply of ink.



Detail shows where pen stores ink and how it flows

POPULAR MECHANICS

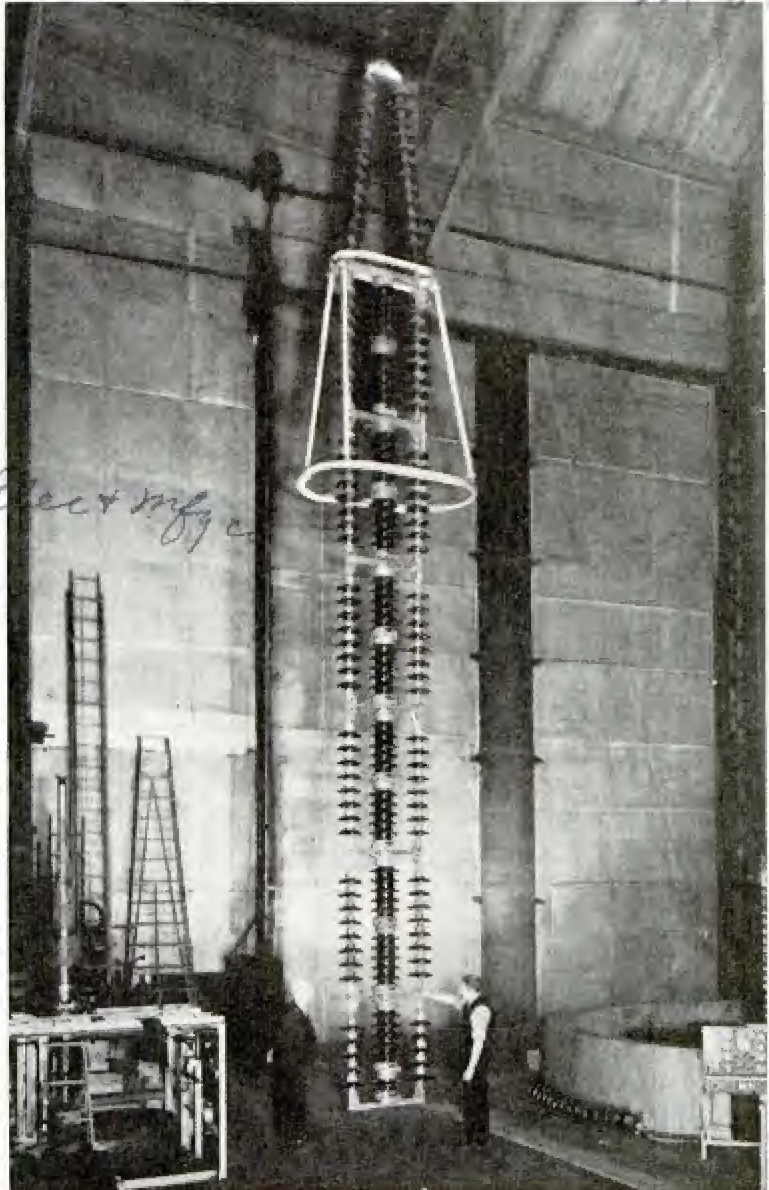
Dist. by Wm. Hersted Co., 822 W Jackson, Chicago

Planet of Weber & Horner & Fiftures Co. Los Angeles Calif

Dr. Dr. Elliott McClure Ord, Neb.

Jointed Lightning Arrester Resists Earthquakes m 848

Built specially to withstand the shocks of an earthquake, a 40-foot-high lightning arrester assigned to the highest voltage power line in the world has been provided with flexible joints allowing it to bend in any direction so earth tremors will not shatter the porcelain insulators, as might happen in a rigid, unbending structure of this size. Produced at the East Pittsburgh plant of Westinghouse, the tall arrester will stand guard on the 286,000-volt electric artery carrying current from Boulder Dam to Los Angeles. When thunderbolts strike the power line, their intense electrical charges are detoured harmlessly to the ground through a path of porous blocks inside the porcelain insulators strung along the center column of the arrester shown in the picture.



Long strings of insulators making up this lightning arrester have flexible joints so they bend with the sharp vibrations of an earthquake without danger of breaking any of the porcelain units

Dummy Instruments Teach Pilot Blind Flying on Ground m 862



Without leaving the ground, student airplane pilots can now learn the technique of flying by instrument, using an inexpensive dummy instrument panel, set with cardboard replicas of the dials of all the usual flying instruments. Mounted on the dials are movable pointers and indicators which the student or teacher may arrange by hand to represent problems actually encountered by pilots during flight.

Student pilots learn how to read instruments for blind flying by practice with this dummy panel which can be adjusted by instructor

0-6 length, 22-00 7.2v, 10akwood, Dayton Ohio

ROUGH RIDERS of the Q.M.C.



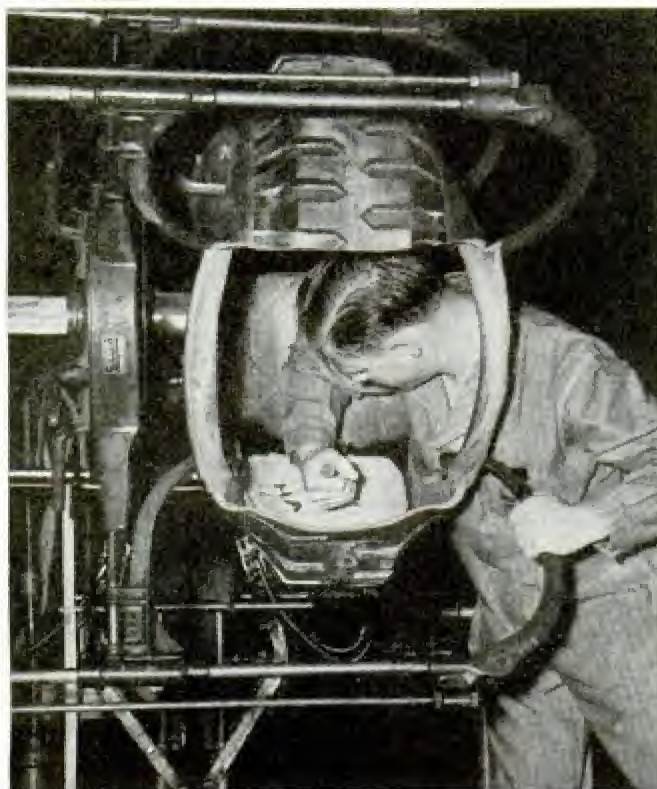
Army motorcycle hits the high spots at Holabird Motor Base in test of stability and recovery of control under conditions to be met in battle

"JEEPS" gallop through mud and thickets and over hills that would stop an ordinary vehicle, motorcycles leap through the air after topping a hill, and five-ton tractor trucks push easily up steep inclines during the 24-hour-a-day testing schedule at the Army's Holabird Quartermaster Motor Base.

What appears to be a continuous show staged by stunt drivers really is accelerated breakdown tests for pilot models of all ordnance motor vehicles of the tactical type. The tests are conducted over one of the toughest test courses in the country, because the Holabird course offers every conceivable type of curve and bump and mudhole likely to be encountered under rigid service conditions.

Before production starts on a model of a vehicle to be built to precise specifications of the arms and services that will use it, the manufacturer submits a pilot model to the engineering division at Holabird. This model is put through a 9,500-mile test which consists of highway, cross-country, and sand operation.

Engineers then give it a careful examination, testing and inspecting all the units and assemblies for fractures, leaks, broken parts, or other defects. If anything goes wrong, the manufacturer's engineers are called in and they, with the army engineers, go over the specifications to correct the fault. After the corrections have been made—and these may range from



Inserting sectional repair in a tire that has been cut away for instruction purpose so that repair operation may be visualized

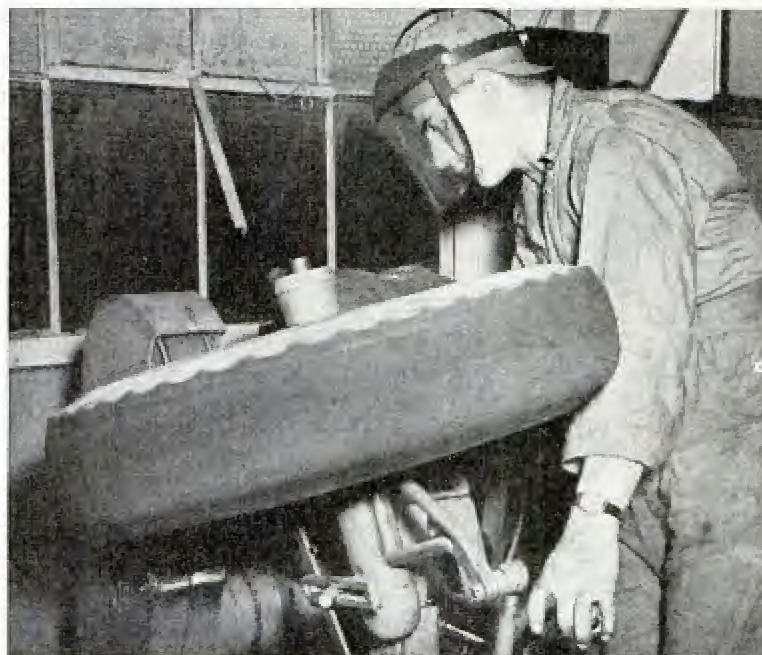
strengthening a weak fuel line connection to a complete change in axle assembly—the pilot model continues under test until the engineers are satisfied it will perform as desired; then it goes into production.

Another special job assigned to the new Holabird course is that of testing special motor equipment and new devices on which the army wants data. The proving grounds depend principally upon a very rough terrain, bogs, and extremely steep grades. Trucks frequently sink several feet deep in the thick muck of mudholes and the light cars and motorcycles may come up with broken parts as the result of climbing an incline, leaping over the top, and landing on the downgrade.

Drivers who put the pilot models through



↑
One of the army's tough little quarter-ton trucks is caught by the camera as it tops the brow of a hill on the tortuous test course at Holabird Motor Base



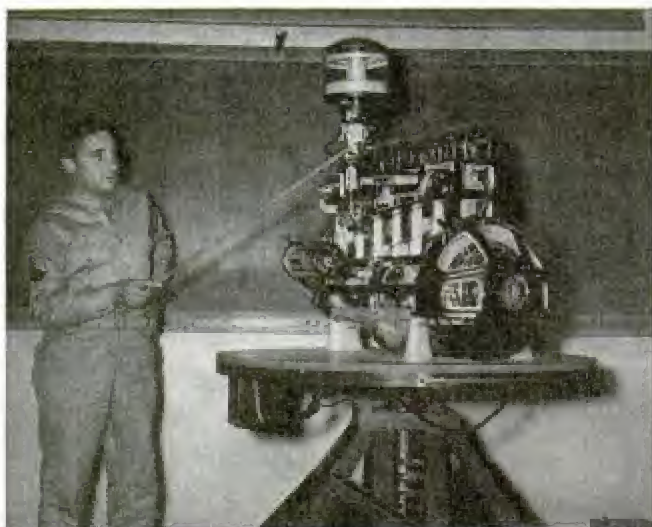
← His eyes protected by a shield, a private removes old tread rubber preparatory to applying new tread. The men are trained for all phases of field servicing

With truck bonnets up, the service class goes to work on engine repairs. Notice, at left, the gasoline-operated generator for charging batteries in field

their tests are limited to three hours of test work in 12 hours of duty when they are conducting tests of a more violent nature.

Vehicles are also used for instructional purposes. High-ranking officers take a series of courses in the motor transport school at Holabird in preventive maintenance. On the last day of one of these courses, generals, colonels, majors, and captains who are in





Instructions in engine repairs are made easier by using this transparent engine built to reveal interior and working parts

Army vehicles must be good "mudders." Below, a 2½-ton, six-wheel-drive truck plows through muck on the Holabird course



Helmeted students are given an electric welding demonstration to prepare them for the servicing of army vehicles in the field



the class drive different types of vehicles on the test course in order to gain practical experience in what the vehicles will do.

Junior officers, taking longer courses, practice driving the trucks over the test course, but, equally important, they go through classroom sessions, wrestling with ignition systems, carburetors, and axle assemblies, learning the fine points about lubrication and maintenance. These officers come from the cavalry, the infantry, the armored force, the corps of engineers, the ordnance department, the field artillery, and the other arms and services. Uncle Sam's fighting forces are dependent upon motor transportation. Officers' courses in the school fit them for the duties of motor transport supervision in the field.

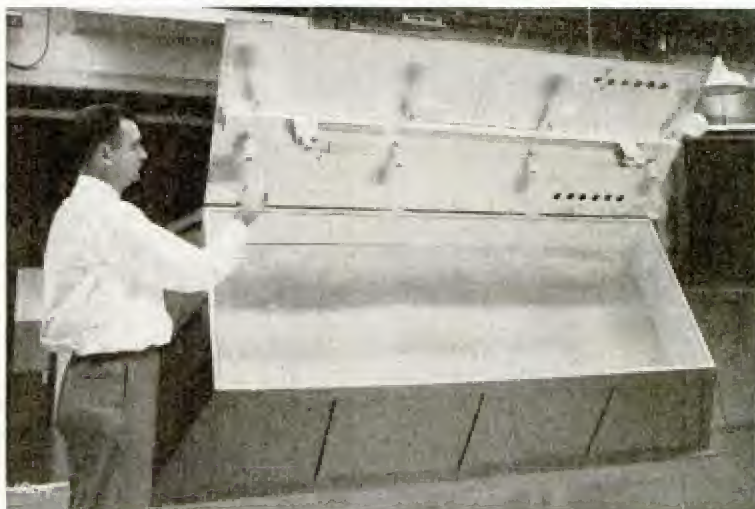
Enlisted men by the thousands are also being trained in the school. The first month of the three-month general automotive course is spent in carburetion and electrical units, maintenance and repair; the second month is spent in engines: rings, bearings, valves, and light maintenance work; and the third month is spent on chassis.

A number of other courses are conducted at Holabird for soldiers, each touching upon some phase of motor transportation. In the sheet metal and radiator repair course, which lasts three months, the students learn the art of hammering out metal, how to straighten and hammer out crushed fenders and bodies of vehicles, and how to repair radiators. Welding and brazing also are covered. Then there is a course on motorcycles. This is the only course in which driving instructions are given.

The complete list of courses for the enlisted students includes: general automotive mechanics, Diesel, carburetion and electrical, inspector-foreman, motorcycles, machinist, blacksmith and welding, sheet metal and radiator repair, automotive parts, tire repair, body finishing, advanced engines, and advanced chassis units.

Glareless Electric "Sun" Lights War Plants

What is claimed to be the biggest and most powerful industrial lighting fixture ever made has been designed specially for defense plants by experts of General Electric's lamp department at Cleveland, O. Made of special fiber board, with a translucent bottom of ordinary tracing paper, the boxlike fixture of the "jumbo luminaire," as engineers call it, is eight feet long, four feet wide and two feet deep. Arranged within the "box" are a 3,000-watt mercury tube lamp and a battery of eight 200-watt frosted filament bulbs, consuming 4,600 watts, but giving as much light as would seven or eight 1,000-watt filament lamps. Use of the filament lamps aids in color discrimination and minimizes the stroboscopic, or flicker, effect produced by mercury type lamps. Diffused by the tracing paper, the powerful light—nearly 150,000 lumens—covers a wide area and falls on the work without creating glare, thereby aiding production



Glareless light, top, installed. Bottom, lifting cover to change bulbs

and accuracy in working with shiny surfaces such as polished sheet aluminum.

One-Man Lifter for Big Barrels Moves 800-Pound Load



Left, slide grip locks over the top rim; right, lifting wedge at base of bar is pushed under the barrel

Heavy barrels and drums that must be moved in a vertical position can be handled by one man with a lifter that rolls on three wheels. It consists of a lifting wedge that slides under the barrel and is connected by a metal bar with a slide grip that locks over the top rim. A handle attached to the bar is pushed down to raise the lifting wedge and engage a latch lock. After the barrel is moved, the latch lock is released and the handle raised slowly to set the barrel down. The carrier is available in three sizes.

☐ To learn where to buy commercial products described in these pages, see the index.

JANUARY, 1943

Ernest Magic Carrier Sales Co
1436 Jefferson av., Buffalo, N.Y.

Bill Warren Photo, 7 Park Ave N.Y.C.

JEEPS on the FARM

7M 774

*and the little machinery job
Auburn Ala*



Right now the jeep is not looking for a job. It has plenty to do, and is doing it in every quarter of the globe. But it will be different after the war, and to keep the jeep out of unemployment the Department of Agriculture has been testing it as a potential postwar work-horse. Above, it is hauling produce to market; at left, a jeep pulls a spike-tooth harrow. Below, the war baby pulls two 14-inch plows cutting furrows six inches deep



In tests at Auburn, Ala., the army's reconnaissance car proved a versatile source of power—except for working row crops. Right, operating cotton or corn planter



Willy-Overland Motors Inc.
Dale, Ohio



† Trying out the jeep's talents on a mowing job. Government experts say the jeep could be highly useful as supplemental power for light plowing, road use, and general field work, but it is too low and narrow for most row-crop cultivation jobs

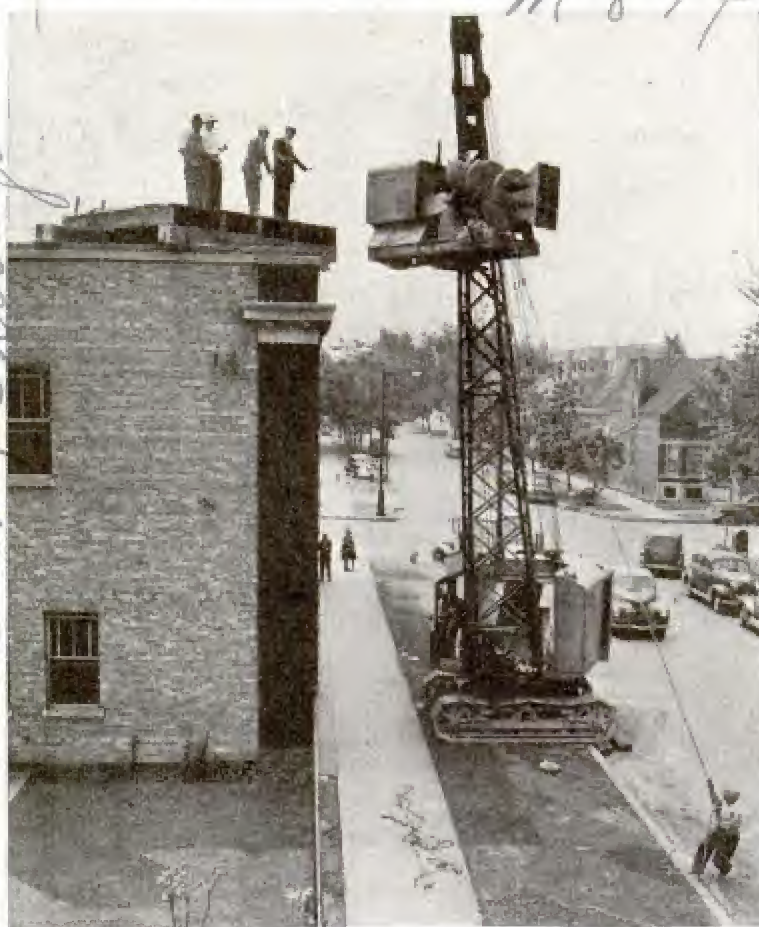


This bucking bronco of the army is tough enough for the rough work encountered on the farm (above). It could "ride herd" like a cow pony, pull like a draft horse. The tests included power pulls against a dynamometer (left), during which the jeep developed a 1,300-pound pull with almost no wheel slippage. The four-wheel drive with six forward and two reverse speeds offers plenty of pull for field operations, and the front wheel drive can be disconnected for road work. The jeep's engine develops 60 horsepower



Two jeeps team up to plow and prepare a seed bed. Using one gallon of gas to the acre, a jeep disked a 20-acre plot so muddy that chains were needed on all wheels

Derrick Hoists Heavy Air Raid Siren To Special Platform on Roof



Lifting one of Chicago's 5,000-pound air raid sirens to roof of fire station. Twenty of the sirens, audible nine miles away, are being installed

Five-thousand-pound air raid sirens purchased by the Chicago Office of Civilian Defense are hoisted to specially constructed platforms on roof tops with a derrick. The giant noisemakers that can be heard nine miles away are lifted vertically and then swung into position. They operate on rotating tables.

Electric 'Watchdog' in Ship Stack Could Help It Dodge 'Subs'

Telltale trails of smoke, making it easy for Axis submarines to spot Allied vessels from great distances, could be avoided by installing an electronic tube in the smoke-stack to relay a warning to the ship's fireman as soon as smoking begins, according to a suggestion of W. C. White, director of General Electric's electronic laboratory. This arrangement would be similar to pho-

to tubes now working in many industrial plants to warn of smoking stacks for the purpose of saving fuel. A beam of light thrown across the smoke column within the chimney shines directly on the photo tube. When thick smoke begins to pour up the chimney and blocks the light beam, the photo-tube works a relay which immediately sounds a warning signal for the fireman. This would enable him to correct the smoking condition.

Adjustable "Teeth" For Hand Plow Fit in Bar

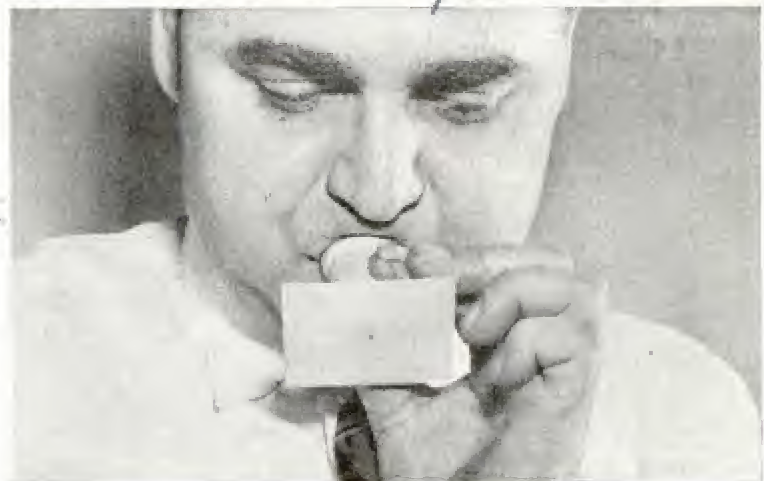
Gardening is speeded up and parallel rows assured with a hand plow that digs six furrows at one time. Constructed somewhat similar to a rake, the tool has V-shaped "teeth" that fit into a series of slots in the bar. Numerous slots make it possible to space the furrows according to the desired width.



Digging six furrows at one time with hand plow that is pulled like a rake. V-shaped teeth fit in slots

Parlor Trick Solves Problem of Handling Steel

Place a small piece of cardboard beneath a spool, stick a pin through the paper simply to keep it from sideslipping, and blow through the spool. You'd expect the cardboard to be blown away. Instead, it adheres to the spool so long as you keep blowing. That simple parlor trick has been converted to a factory trick that has speeded up nearly 80 percent the production of steel plates for electric air cleaners at the Westinghouse plant in Cleveland. An 80-pound blast of compressed air forced through a quarter-inch hole in the top bed of a punch press lifts and supports a steel plate eight by ten inches, eliminating a slow method of prying the plates by hand from the bottom bed of the press. By hand, 585 plates per hour were handled; with the air blower, 1,000 an hour. The explanation of the trick is that air, traveling at high speed exerts less pressure on its surroundings than air at rest; hence the cardboard or the steel plate is pushed harder by the still air beneath it than by the high-speed air above.



Top, removing steel plate which was lifted from punch press by downward air blast. Below, the parlor trick that was "mother" of the invention

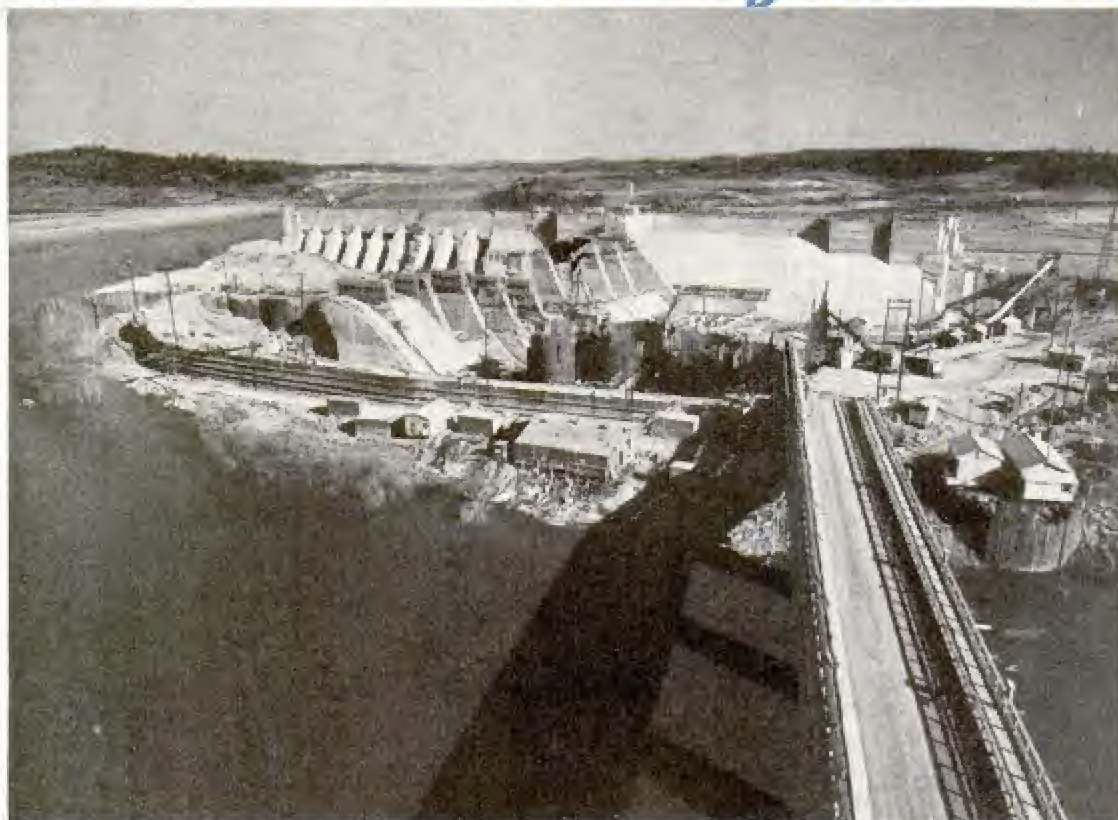
Rubber Replaced by Plastic From Cotton and Alcohol

Rubber now used in hundreds of everyday articles may be replaced by a new plastic made from cotton and alcohol. Although its "bounce" and resiliency is inferior to that of natural rubber, the substance, having an ethyl cellulose base, can be compounded into tough, pliable, flexible and thermoplastic compositions suitable for hospital sheeting, tents, hose and tubing, surgical tape and rubber gloves, electrical tape and wire insulation, Mason jar

rings and washers, footwear, raincoats and golf balls. Since the material is resistant to war gases, it can be used for gas masks. Remaining flexible at temperatures of 70 degrees below zero, it is suitable for electrical insulation in motors of high-altitude bombers. However, it will tear more readily than rubber and is not as elastic, so it will not do for tires or inner tubes. On the other hand it can be made flameproof and produced clear or pigmented.

Mr. Whittaker

VICTORY DAMS of the TVA



Fort Loudoun dam, one of TVA chain on the Tennessee river, being built on 24-hour wartime schedule to produce needed electric power for plants turning out aluminum for thousands of planes

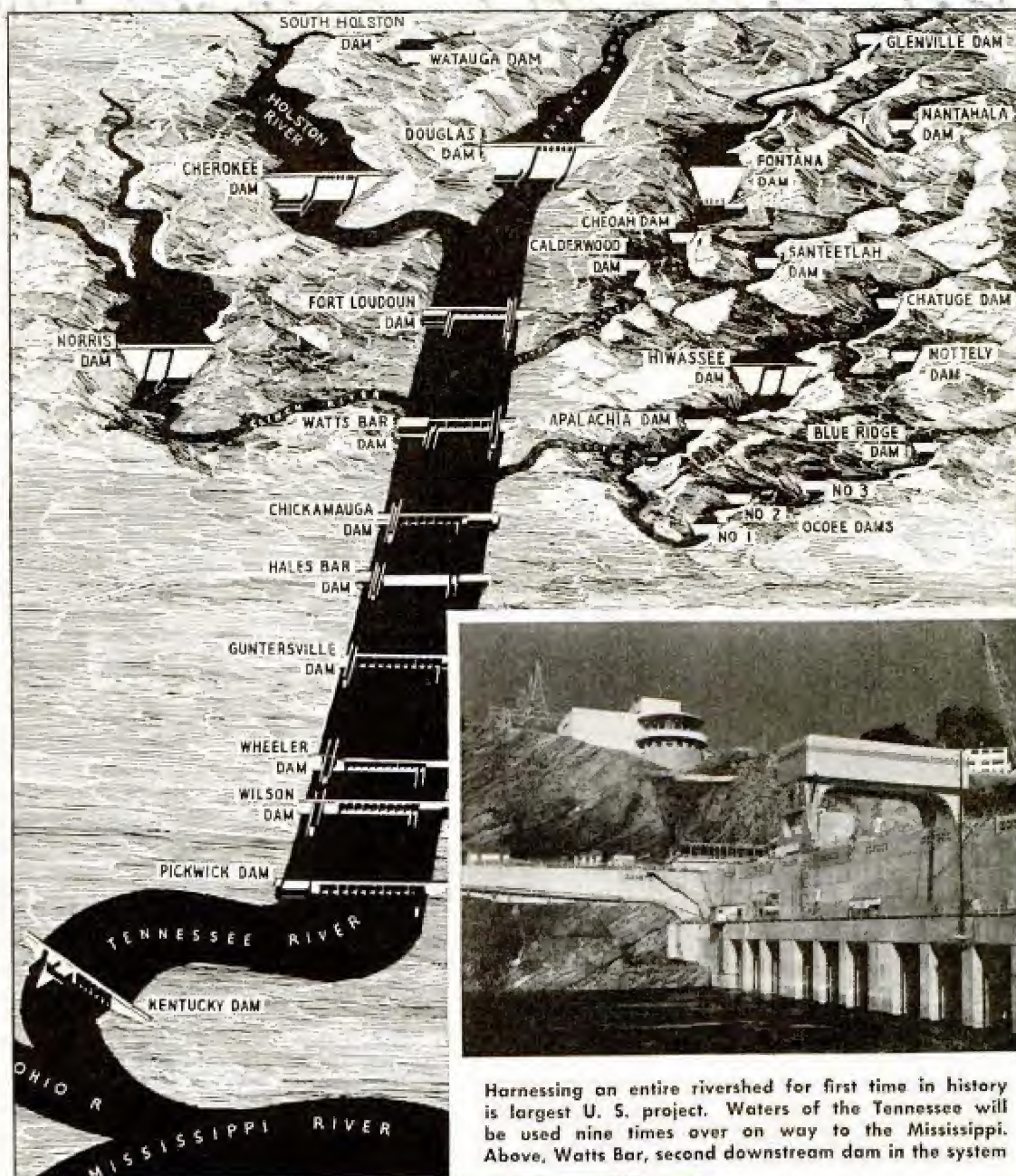
THEY'RE burning the midnight oil in the Tennessee Valley. Glaring 3,000-watt lamps illuminate the muck of river beds. Behind cofferdams thousands of men are working overtime to finish a dozen new hydroelectric dams to provide more power for war industries in 1943.

7M 843
The Tennessee Valley Authority is making history by building concrete monoliths by the dozen. Mountains of earth and shale are moved; countless tons of gravel and sand churned into concrete; thousands of pounds of steel parts fitted into vital sections of the great dams, and millions of man hours are being poured into this TV (for Victory) A project.

Extra generating units installed in the dozen dams now in operation await the increased water flow to spin the hungry blades of their turbines. Power from the system flows directly into the South's big aluminum, chemical and electrometallurgical plants. These industries are straining to



Tallest of the dams is Hiwassee backing up a lake 22 miles long. Like other storage dams, it releases water to main power dams



Harnessing an entire rivershed for first time in history is largest U. S. project. Waters of the Tennessee will be used nine times over on way to the Mississippi. Above, Watts Bar, second downstream dam in the system



produce the materials for bombers, explosives and other critical war products in unheard of quantities.

The TVA already supplies a large amount of power for the aluminum industry which must produce enough silvery sheets of the lightweight metal to build 125,000 warplanes in 1943. Experts say the completion of the new dams—espe-

Write: Maurice Hinkle Chief, Information Service Staff, TVA, Knoxville, Tenn.



Here is TVA's demountable house used in construction camps and designed for trailer transportation. This war housing aid can be put up in a jiffy

cially Douglas—will assure the goal set by the aluminum companies.

Ever since the TVA was created as a federal agency nearly nine years ago, somebody has been saying its job either couldn't or shouldn't be done. These controversies are now forgotten and the only question is: "How soon and how much?"

When the vast project is completed—the largest single construction program ever undertaken in the U. S.—its present capacity of slightly more than 1,000,000 kilowatts will be tripled and the yellow waters of the Tennessee river and its tributaries

and the final turbine in place, an entire rivershed will be harnessed for the first time in history.

The system cuts across three states and part of a fourth. It starts from the finger-like tributaries of the Tennessee river on the slopes of the Great Smokies in western North Carolina and eastern Tennessee, follows the great bend of the river that dips into Alabama, sweeps north across Tennessee and Kentucky to Paducah where the stream joins the Ohio river.

There are two types of dams in the system; those built primarily to store up flood

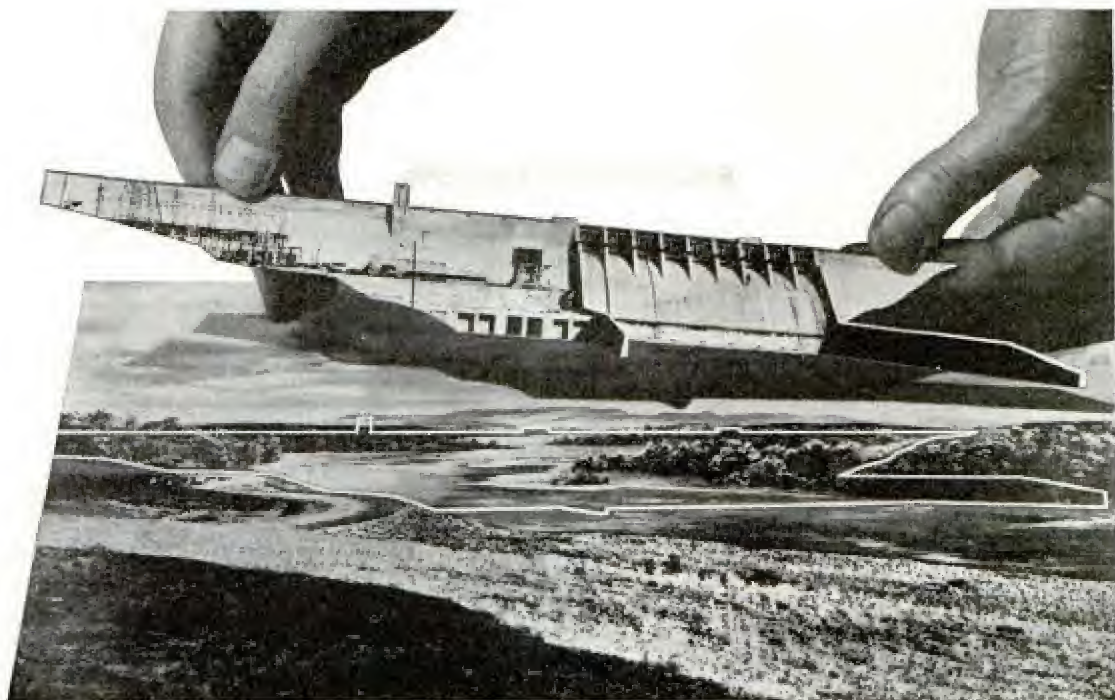
will supply one-half as much electricity as the entire nation produced during World War I.

The question of time is being met every hour by the mud-streaked workers manning cat-wagons loaded with dripping clay or operating giant power shovels cutting their way to bedrock for the laying of concrete, by others at gantry cranes, by the army of skilled and unskilled workers, and the huge staff of design engineers always on the job.

When the last bucket of concrete is hardened

When Kentucky dam, near mouth of the Tennessee river, is completed it will create new inland lake of 256,000 acres. The \$107,500,000 dam will be 166 feet high and 8,650 feet long





If miracles could happen Cherokee dam could be lifted over ridge to fit into site of Douglas. Similar sites enable engineers to adapt Cherokee designs to build Douglas in record time

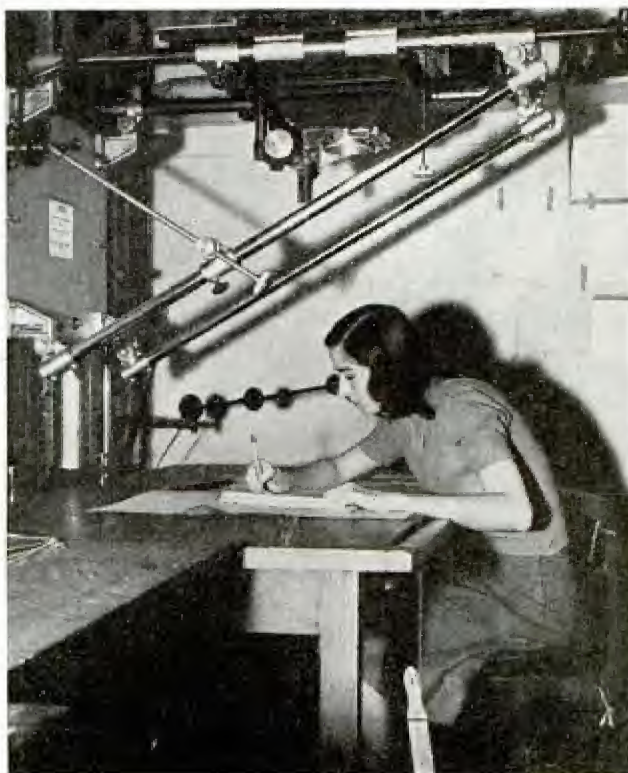
waters and others to produce power. The storage dams are built across the mountain tributaries, creating reservoirs holding millions of gallons of water that are released to meet the needs of the power dams in the main stream.

Six of the power dams—Pickwick Landing, Wilson, Wheeler, Guntersville, Hales Bar and Chickamauga—are now in operation. Three more—Kentucky, Watts Bar and Fort Loudoun—are well under way. Eventually, as the water drops down the valley it will be used nine times over to produce electricity. The storage dams are also equipped with generating units so that no fraction of water power is wasted.

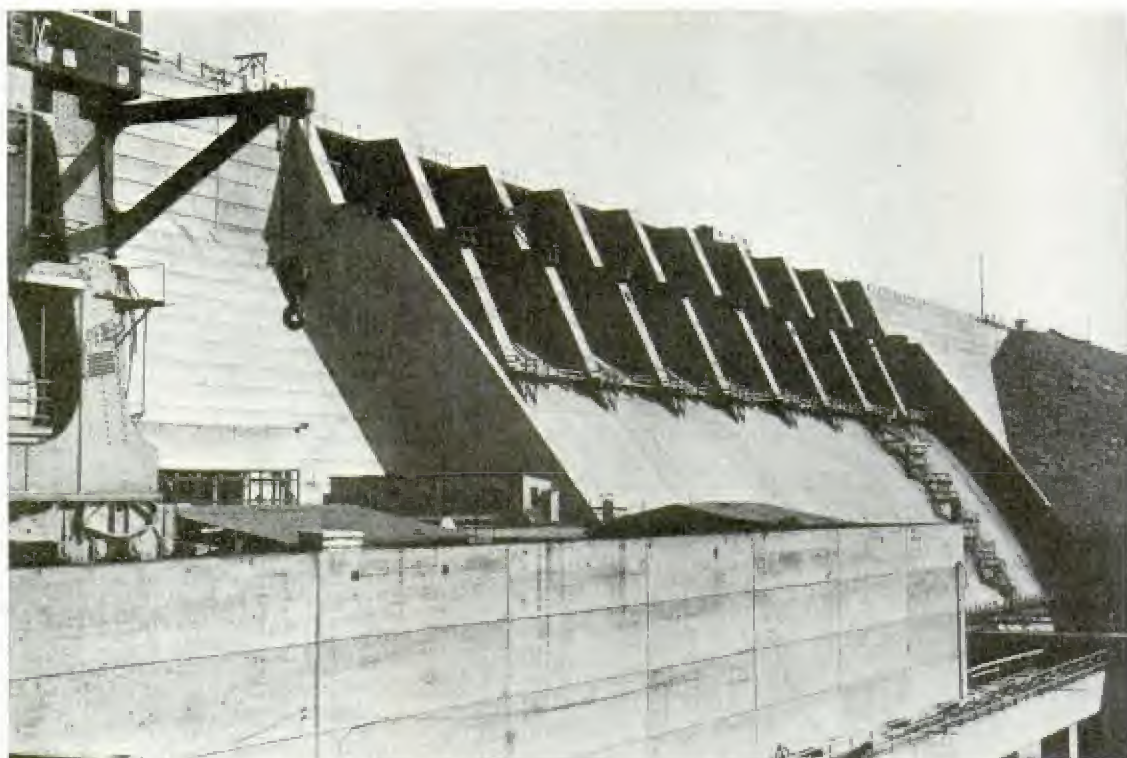
At present TVA engineers are speeding the construction of Douglas dam in a race to beat the deadline set by the spring rains that will flood the French Broad river. A delay of two or three months will mean the loss of a full year's production of electric power.

Normally, it would take a couple of years to build a structure like the

Douglas dam. To produce current in 1943 it would have to be built in 13 months. It was pointed out that custom-built equipment for a dam requires two to four months to design, often another 12 months to manufacture—a time bottleneck that cannot be



Taking the place of map draftsmen now in army are many women workers being trained to fill TVA jobs ordinarily held by men



Cherokee dam on the Holston river was built in 16 months—four months ahead of schedule. This giant storage dam feeds flood waters into spinning turbines of the main river power dams

avoided. Complicating the problem of obtaining tailor-made steel castings, turbines, generators, spillway gates and cranes were the increased war demands on industrial plants.

When the situation looked blackest, Col. T. B. Parker, chief engineer of the TVA, and his staff of topnotch design engineers

pulled a trick that will go down in the history of dam building. First, they announced that the dam could be built in 13 months. They explained that requirements for the Douglas were so similar to the recently completed Cherokee that whole portions of the latter's design, beginning with the massive concrete section of the dam itself, could be used.

A week after the Douglas was authorized the plate steel penstock liners were placed on order. Two days later the gate hoists were ordered. On the 20th day the turbines and governors. On the 31st day the structural steel for the powerhouse. Orders for sluice gates, trash racks, head gates, generators, transformers, switchyard equipment and other vital items were rushed to the factories. By the end of the fifth week after the authorization of the project, all the critical equipment was on order!

A few days after the authorization, men were moved overland by truck from the Cherokee dam along with construction gantry cranes, concrete mixer plant, machine shop, carpenter shop, water system, warehouses and dormitories. Even the



Trained in the TVA's apprentice school for workers, this journeyman machinist is a former sharecropper

construction trestle at Cherokee was moved to Douglas.

Looking forward to the completion of Douglas, four extra 24,000-kilowatt generators are being installed at Wilson dam, 400 miles down the Tennessee river.

While Boulder dam, as well as Grand Coulee in Washington and Shasta in California, lay claim to various distinctions in size, the dams of the Tennessee Valley vie with each other for superlatives. There's Douglas with a construction time record that beats them all; Kentucky, near the mouth of the river, longest when completed (8,650 feet) and most costly (\$107,500,000) in the system; Hiwassee, tallest (307.5 feet) of the present dams which will be topped by Watauga (318 feet) and Fontana (460 feet), when they are finished; Wheeler in Alabama, longest all-concrete mainstream dam; Fort Loudoun, farthest upstream, and Norris with the greatest storage capacity at present.

The reservoirs of the main river projects are designed to provide a channel for boats of nine-foot draft from the mouth of the river to Knoxville, a distance of 650 miles. The inland waterway is already completed to Chattanooga and goods now being transported include wheat, petroleum products and pig iron.

Aside from building dams to provide electric power to keep war plants humming, the TVA has made contributions to the nation's welfare from its research laboratories and in cooperation with state engineering and agricultural experimental stations. One of the outstanding results is the development of a process for the extraction of alumina, the raw material of aluminum, from clays found plentifully in this country.

In the field of housing, the TVA offered to the war program the results of eight full years of experiment in providing homes for workers. The authority's demountable house, complete with electric, water, sanitary and other installations, is designed for trailer transportation and can be erected in four to six hours.

The TVA, established by Congress "to provide for national defense," in the words of the TVA act, has created a hydroelectric powerhouse for national offense. When its system of 24 dams—all built by the authority except five small ones—is finished, it will have cost the nation more than half a billion dollars.

JANUARY, 1943

Lamp Kills Germs in Shoes To Stop Spread of Infection



Light treatment rids shoe of infectious bacteria

Spreading of foot infection through safety shoes is prevented at Westinghouse East Pittsburgh works by sterilizing the shoes with ultraviolet rays from a hairpin-shaped tubular lamp. In a month's time about 1,000 workers at the plant buy the steel-capped shoes, and in most cases it is necessary to try on several pairs before making a selection. Before going back into stock, the shoes get a germ-killing treatment lasting two to five minutes.

Wrench Has Self-Adjusting Jaw Held in Position by Spring

Nuts of varying sizes are held in a strong grip with a self-adjusting wrench that has



a movable jaw held in position with a spring. The grip on the nut increases with the amount of pressure on the handle. Teeth in the jaws also grasp pipes or bolts. The wrench is made in several sizes.

Heller Bros. Co.
865 Mt. Prospect Ave
Newark, N. J.

"Wishbone" Draws "Seam" On Makeup Stocking



Photo, Max Factor, Jr.
Straight lines are easy to draw with "seam guide"

To simulate a perfectly straight seam on painted-on "stockings," a Hollywood make-up expert fashioned a "seam guide" that anyone can handle with accuracy. It consists of a screwdriver handle, a strip of spring steel, a pencil clip and an eyebrow pencil, which required only a few dabs of solder in the right places to hold them together. The guide is used only to trace a light line, which then can be gone over freehand with a heavier application of crayon or mascara.

Portable Battery Air-Raid Siren Heard for 2,000 Feet

Weighing only 20 pounds, a battery-operated air-raid siren can be carried by



Siren may be carried about and pointed any direction

hand for sounding emergency warnings when the regular power fails or in factories where the din of machines at work may drown out the wail of outdoor sirens. The signal is turned on by a fingertip switch, its sound being heard 2,000 feet away in the open. Dry batteries used in its operation give thirty hours of service.

Wood Tires for Farm Tractors Made With Lugs on Rim

Wooden lugs attached to the rims of tractor wheels are substituting for rubber tires on the tractors owned by many Kansas wheat farmers. The lugs are fastened to the rims by iron rods and about 15 are required for each wheel. They are applied



Wood tire on tractor (top) and compared with rubber

at an angle across the rim and slightly tapered to give a bearing surface on the ground of about an inch and a half. Farmers report that the lugs give plenty of traction and cause little additional vibration. They were developed by the Office of Price Administration in Wichita.

By measuring light refraction, a new instrument can be used to control petroleum distillation, measure the concentration of sugar products or the dilution of milk.

refractometer
POPULAR MECHANICS
News Bureau of America
Optical Co, Southbridge, Mass

*Office of War Information
Washington D.C.*

Latest M-4 Tank Has Superior Firing Power

M 892



With its 75-mm. cannon protruding from the turret, the newest member of our Armored Force tops a hill at Fort Knox where it has gained popularity with hard-bitten "tankers." A smaller cannon and high-powered machine guns add to its lethal bite. Below, on test maneuver

One of America's new M-4 tanks hits its stride on a steep hill during a trial run on which it performed brilliantly, according to experts of the Armored Force. Successor to the M-3 which saw plenty of action on the African desert, the new tank with a superior cast steel hull and increased firing power has a turret which revolves in a complete circle. Below, the improved M-4 is shown at the left lined up beside an M-3 to take on fuel at Fort Knox, Ky., the training center for tank crews. Note how the position of guns is changed



HEAVYWEIGHT SLUGGERS



One of Uncle Sam's most powerful machines of war is seen beneath the 16-inch guns of a sister dreadnought

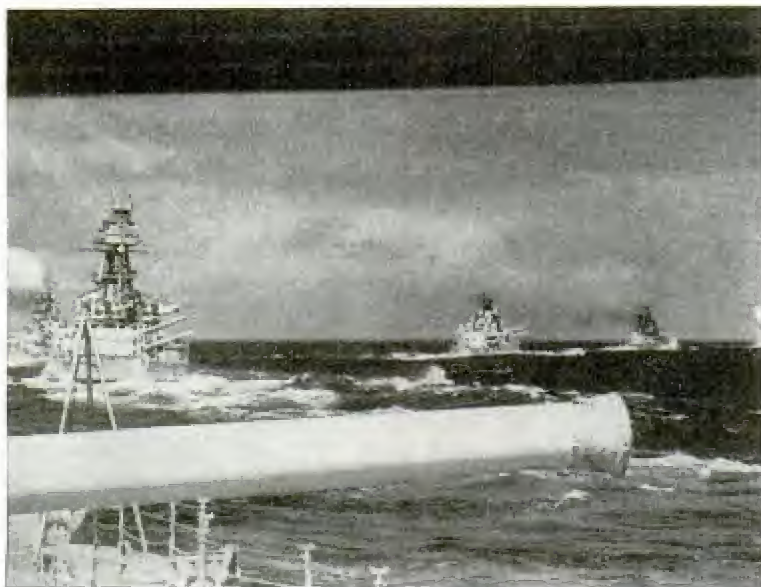
IT WAS said of Admiral Beatty, commander-in-chief of the British fleet at Jutland in 1917, that he was "the only man in the world who could win or lose the war in an afternoon."

The significance of this statement is as meaningful today as then. Stated in sim-

plest terms: the mastery of the blue water of the Atlantic and Pacific will be determined when the great battleships of the American and British fleets knock out the battleships of the Japanese and German navies.

Encounters between individual ships, divisions or task forces—no matter how spectacular—are but the preliminary bouts before the main event. The issue is decided when one line of battlewagons meets another line of capital ships, and the great heavyweight sluggers of the sea start tossing tons of steel and TNT at one another.

As this is being written, World War II has not yet produced a full-dress naval encounter. Even the Coral Sea and Midway



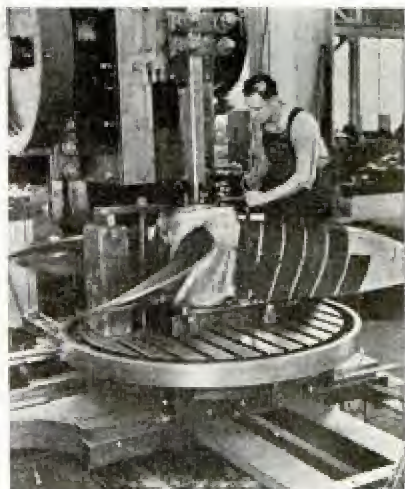
A line of battleships cruises in formation, turret guns ready

Cont: Lt. A. J. Hamilton, 1177 1/4 S. Westmoreland Ave Los Angeles Calif

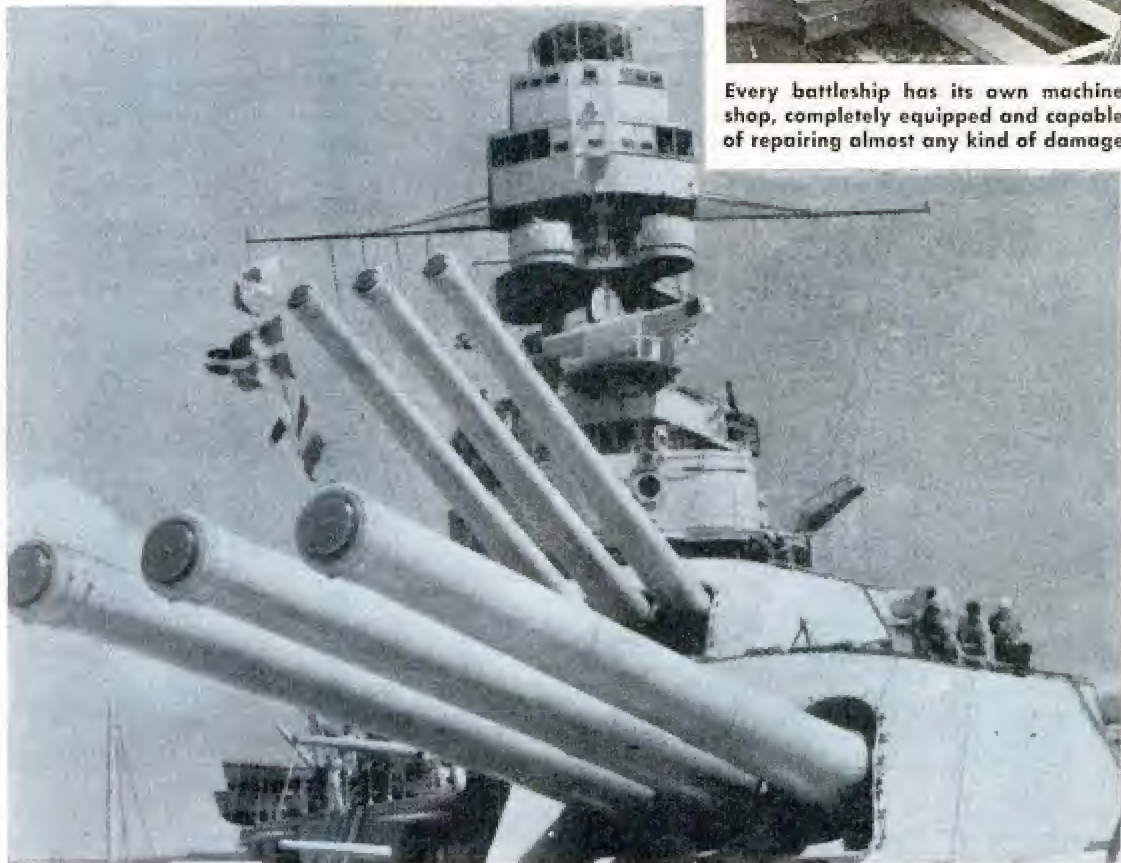
OF THE SEA

battles were not titanic struggles between two lines of battlewagons. When it does occur, and the battleships of one side are sunk or crippled, you may put it down as one of the great moments of the twentieth century.

The battleship is the Joe Louis of sea warfare—the heavyweight champion of the deep. These great floating fortresses, often called “the most complicated pieces of machinery ever devised by man’s inventive genius,” are the backbone of any nation’s fleet. Around them are grouped the aircraft carriers, cruisers, de-



Every battleship has its own machine shop, completely equipped and capable of repairing almost any kind of damage



stroyers, submarines and auxiliaries. In the days of John Paul Jones and Admiral Nelson, the biggest and most powerful ships were called “ships of the line” or “line-of-battle ships”—hence the origin of the name battleship.

The grandpappy of the present-day American battleship was the *Maine*, built in 1886. It was strictly a battle cruiser, later classified as a battleship. The first modern battleships were the *Michigan* and *South Carolina* which entered service in 1909. Even now experts can’t quite agree on the precise definition of a battleship except that it is the biggest, carries the most guns, and is most heavily armored.

Since the historic *Maine*, the United States has

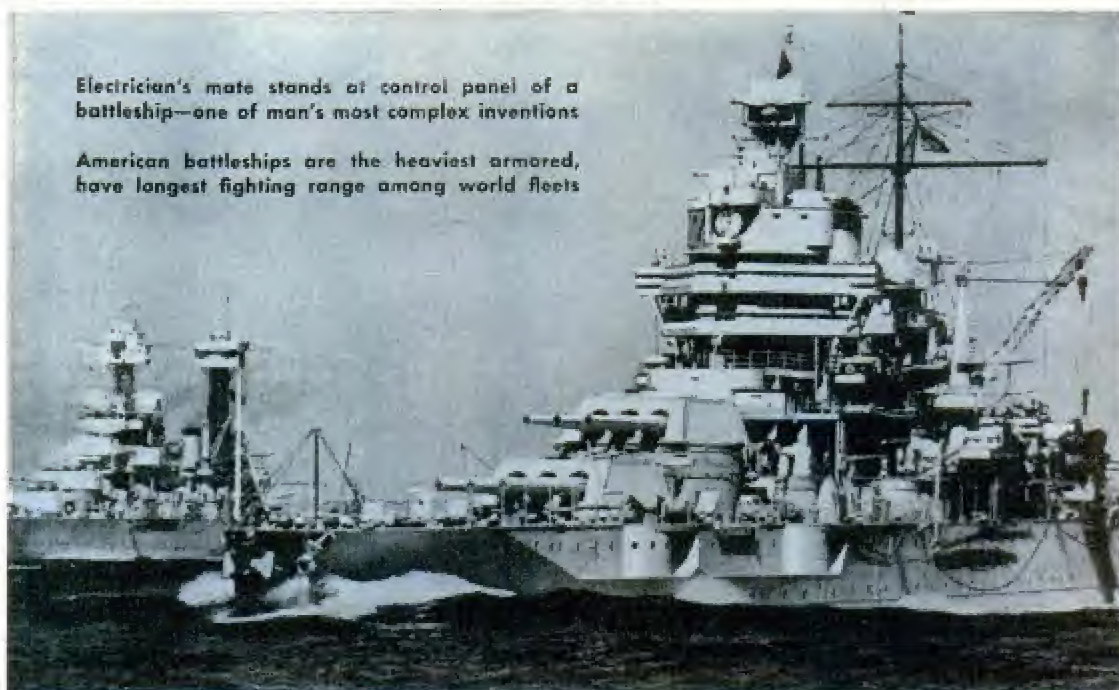
Above, the six 14-inch guns of the Pennsylvania’s forward turrets. Below, standing “throttle watch” aboard U.S.S. *New Mexico*





Electrician's mate stands at control panel of a battleship—one of man's most complex inventions

American battleships are the heaviest armored, have longest fighting range among world fleets



Antiaircraft guns guard the battleship against its new foe, the bomber. American gunners can match the best in the world



built, might have built or is building 71 battleships. Some 39 have been built or partially built, and scrapped, 17 are in service, and 15 are being built or are on order.

A battleship represents a compromise between speed, gun power and armor. British battleships, designed to be never more than 1,000 miles from a naval base, emphasize guns and speed. Italian ships are even speedier because they have been built for the Mediterranean. German ships, designed for the shallow waters of the North

Sea and Baltic, are of broad beam and possess complicated underwater protection. Japanese battleships carry heavier armor than the British ships from which they were copied. Russian battleships have heavy bows for breaking ice.

American battleships have been built to fight an enemy 3,000 to 5,000 miles from our own coasts. Speed has been sacrificed for other qualities. Top speed of most of our battleships is between 19 and 21 knots. But ship for ship, the battlewagons of Uncle Sam have the greatest cruising radius and the thickest armor of any in the world—just what is needed to

fight a great battle many miles from home and then return.

In our newest ships, however, such as the 35,000-ton North Carolina and the Washington, and others now under construction, speed has been added. Able to cruise at 27 knots, they will be the speediest as well as the biggest and hardest-hitting battlewagons afloat.

A battleship must take the kind of punishment it delivers. Other battleships may pound her with big guns; submarines, destroyers, P-T boats and planes may launch torpedoes against her sides; mines may tear holes in her hull. But a battlewagon must absorb this punishment and keep on slugging. Specially hardened steel, 16 inches thick, protects her against torpedo attack at her waistline. Her turret armor is even thicker. Deck armor is four to six inches thick. Also thickly armored is the conning tower to which many vital controls lead and from which, during battle, the commanding officer runs the ship. Antiaircraft gunners are given protection from flying splinters of steel. Below decks the ship is honeycombed with double compartments and false bottoms so that if one part is hit by a shell or torpedo only part of the hull will be flooded.

A battleship can take terrific pounding from bombs, from planes and shells, and from other ships before going down to Davy Jones' locker. The German battleships Gneisenau and Scharnhorst were bombed incessantly by the British, yet managed to get out of France into German bases. A battleship is more susceptible to torpedoes, yet it takes four or five to put her out of action.

A battleship like the North Carolina costs the American taxpayer \$70,000,000—as compared to \$27,000,000 for some of our older battleships and \$2,000,000 for the Maine.

But if you think that ships like the North Carolina and Washington are going to give the Japanese a headache, just look at what is scheduled to follow: four 35,000-ton battlewagons of the South Dakota class, six 45,000-tonners of the Iowa class, and five 58,000-ton giants of the Montana class. Uncle Sam doesn't fool around when he sets out to build the world's most powerful navy!

Because the United States will be far ahead of the rest of the world in battleships

(Continued to page 166)

JANUARY, 1943

Press Room 50
Rockefeller Plaza
"Mike" in Gunner's Mask
Carries Orders to Crew
77 932



Navy gunner talking by means of gas-mask "mike"

So he will not be robbed of voice and hearing during an enemy gas attack, a navy gunner wears a mask equipped with microphone and head set. This enables him to receive the range settings and relay them to other members of the gun crew.

Flight-Test Robot Prints Record Of Plane's Performance

77 1031
When a test pilot puts a new plane through its paces, he now takes along an electronic robot that records temperature and pressure changes about 18 times as fast as human recorders can do the same job. Every three or four minutes the flight recorder makes 144 readings, whereas three or more men need half a minute to write down each reading manually. During the test flight of the Douglas B19, the world's largest plane, this instrument automatically printed on paper the temperatures of all 72 cylinders of the four motors, as well as changing temperatures of the carburetor, exhaust and oil in the fuel lines, and also recorded pressures on wing struts, bulkheads and tail surfaces. It can be used on single-seater pursuit ships which must leave test engineers on the ground.

dev: Brown & Stratton
meat co.
Philadelphia, Pa.
61

Cont: Mary Ellcott, 7 Park Ave., N.Y.C.



SWIMMING SOLDIERS

Left, a soldier helps another ashore with a "saddle back" carry, a safe and effective technique used in shallow water

Right, "production line" study of chin holds at Ft. Bragg. Land training precedes practice in water

n.e.



Many army officers were skeptical when the Red Cross asserted that soldiers could be trained to swim with full equipment. But the Red Cross proved it. Soldier "guinea pigs" carrying knapsacks loaded with 60 pounds of bricks jumped into deep water and swam ashore. Since then the army has trained thousands of swimming soldiers like the two above, wearing steel helmets



By interlocking wrists, rescuers form an almost unbreakable human chain to save a man in swift water. This safe method requires no swimming ability



Eliminating strokes that tire a man weighted with 17 pounds of clothing, a 60-pound pack and a Garand rifle, the army concentrates on nine skills: standard breast or side stroke, back stroke, back float, treading water, underwater swim, swimming and floating in restricted areas, plunge diving and leaping in feet foremost. Trainees find that air pockets in clothing and pack provide buoyancy compensating for weight. Above, capsizing a boat to test swimming ability and reactions in emergency. Center, rescuing "victims" with the "fireman's carry." Bottom, troops in three ponton boats simulate a landing under actual combat conditions

"Kick boards" are used to develop the leg strokes, giving buoyancy while the trainees are learning the various styles of leg kicks



Felt & Cameron, 14103 Merchandise Mart Chicago, Ill

Panel in Wooden Lunch Box Opens for Quick Inspection



Box opens quickly for inspection at plant entrance

Handy for war workers, a lunch box constructed of wood requires no strategic metals in its manufacture. A sliding panel at one end opens to permit quick inspection by plant officers at entrance gates, and also gives easy access to the contents at lunch time. In the top compartment a coffee bottle is supported on built-in wooden lugs.

Tiny "Jeep" From Odds and Ends Is Run by Small Gas Engine

Using magazine pictures of the army "jeep" as his model, a mechanic of Win-



Car built after jeep is run by 1½ horsepower engine

built by Ira Denny of Jones Bakeris, Inc.

ston-Salem, N. C., constructed, partly from scrapped auto and washing machine parts, a diminutive car resembling the sturdy military vehicle in many ways except size. From old autos came the steering gear, wheel spindles, headlights and fan pulley for the clutch-tightener. The rear-end differential is from a washing-machine wringer. A bicycle chain is used for the main drive, a radiator vent cover for the front grill and a three-eighths-inch pipe for the steering apparatus. A one-cylinder, 1½ horsepower gasoline engine, which was intended for a well pump, drives the 250-pound car at 20 miles an hour. Wheels are the kind used on wheelbarrows, and the body was formed by welding sheets of old black iron. It lacks a reverse gear, but the driver can put his foot to the pavement and shove the tiny "jeep" backward.

Gauge Measures Bulge of Tire For Best Air Pressure

Proper inflation of tires is assured with a gauge that measures the bulge of a tire instead of the number of pounds of air. It consists of a bar with two adjustable arms,



Correct tire inflation is found by measuring bulge

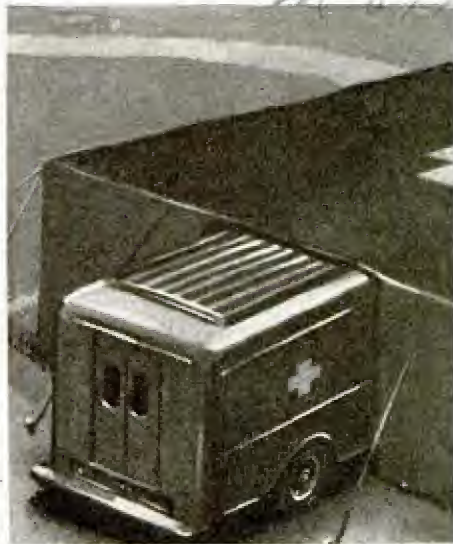
at right angles. The arms are used to measure the tire at hub level and at a point bearing the car's weight. Inventors of the gauge point out that an unbalanced condition is apt to occur when a car is equipped with old and new tires filled with an equal amount of air. Old tires have less rigid walls. The gauge is also used to determine the proper air pressure for various loads.

Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

POPULAR MECHANICS

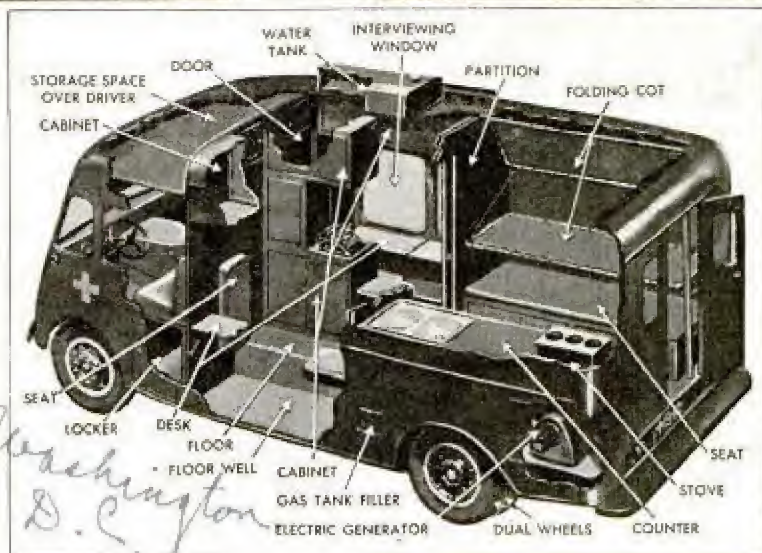
Dear my Co. Rock Island, Ill.

Mobile Red Cross Unit Is Ready for Disasters



Above, a "rolling kitchen" of 1918 beside a new Red Cross canteen. Right, cutaway drawing of mobile disaster relief unit; above it, the unit with tent set up at disaster scene

Anticipating the needs of distressed civilians in the event of an enemy attack or other wartime catastrophe, the American Red Cross has placed in operation throughout the country, or is building, a fleet of 350 mobile canteens, disaster relief cars and ambulances. Completely self-contained, the disaster units are fully equipped to meet essential needs of a stricken population. There are kitchen facilities, pots and pans, food storage bins, running water, cabinets, blizzard lanterns, first-aid kits, stretchers, office accommodations with desks and typewriter, and



sleeping quarters for the crew. The local Red Cross chapters operating these units are providing trained drivers, canteen workers, first-aid and disaster staffs. Some of the trucks carry big tents which can be set up alongside as temporary shelters.

Magnetic Storms Are Traced to Holes Punched Through Ionosphere

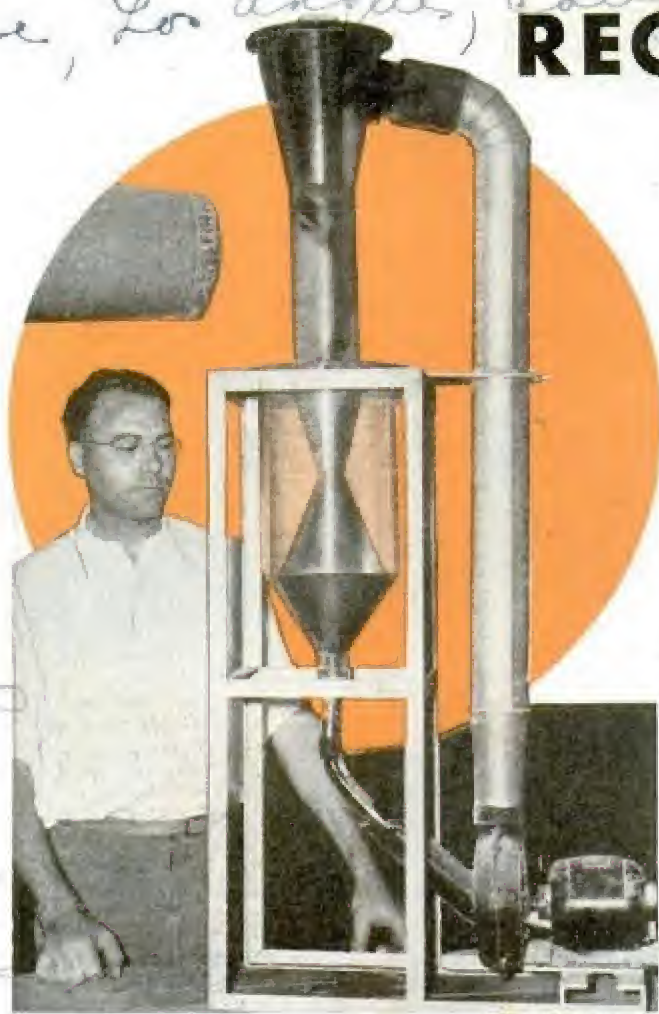
Streams of atomic fragments from the sun punch holes in the ionosphere to cause magnetic storms on the earth, according to a view expressed by T. L. Eckersley of Marconi's Wireless Telegraph Co. in England. These streams, he believes, are neutral, being composed of equal numbers of positively charged protons and negatively charged electrons. This balance becomes

upset, however, because the protons are heavier and therefore penetrate the atmosphere more deeply, and so two oppositely charged layers are formed, the protons below and the electrons above. But a localized neutral stream may sweep a space clear of charged particles, thus leaving a hole in the ionosphere. This is the cause of a magnetic storm, Mr. Eckersley believes.

Thos. E. Sumner, Jr., 3872 Franklin Ave., Los Angeles, Calif.

RECOVERING

M 833



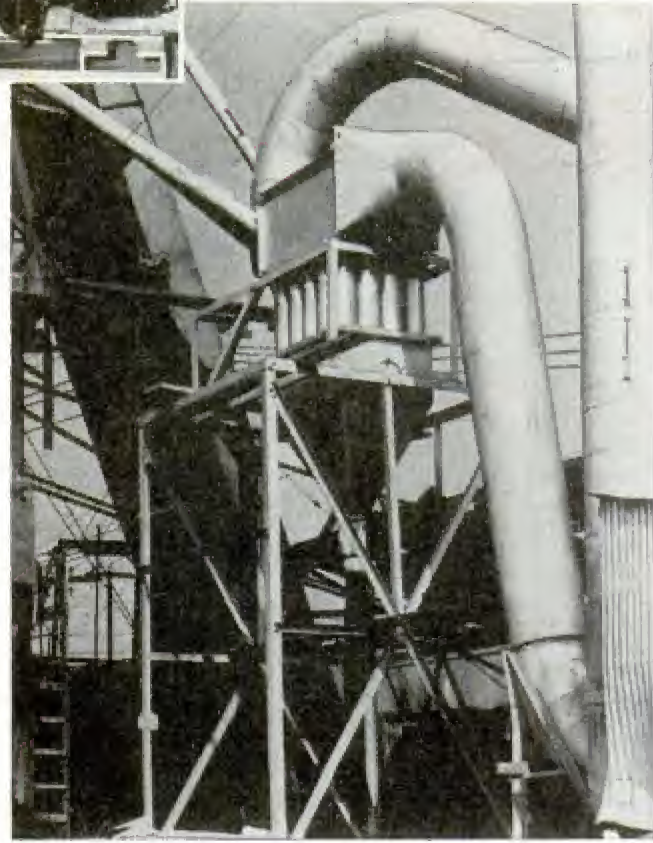
released from the ore during the refining process. Then the sulphuric acid helps extract copper from the ore. Previously, many thousands of dollars a month had been spent to buy sulphuric acid for this purpose.

Ten percent of the cement manufactured at one cement plant was going up the chimneys to be blown as dust over the surrounding countryside until dust collectors were installed to trap and save it. There were still valuable amounts of potash in the hot chimney gases, so an electrical precipitator was put to work. Now the cement company has potash for sale as a by-product.

Industry has learned that many of its smokes and fumes are liter-

Mechanical whirlwind within tube hurls suspended smoke particles against sides, allowing cleaned chimney gases to escape

Waste gas and fumes are whirled through cleaning tubes, below, in asphalt plant



MOST people have heard that sea water contains minute particles of gold but few realize that there are also gold mines in the sky. The fact is that in past decades the United States has blown vast fortunes in gold, silver and other metals up into the air as a part of ore smelting and refining operations.

At one big gold smelter a million dollars' worth of gold and silver that had been drifting away into the atmosphere every year is now being trapped in the smokestacks and recovered.

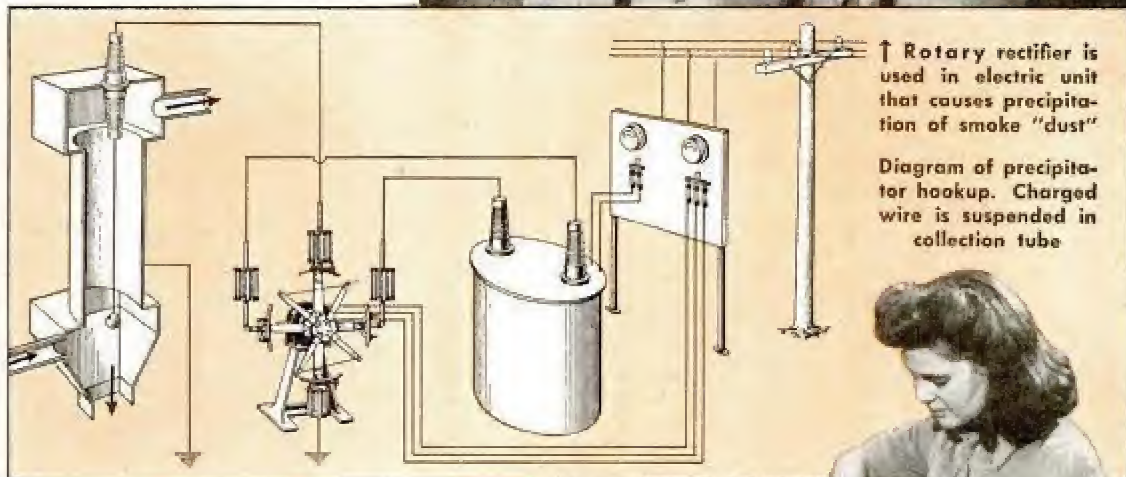
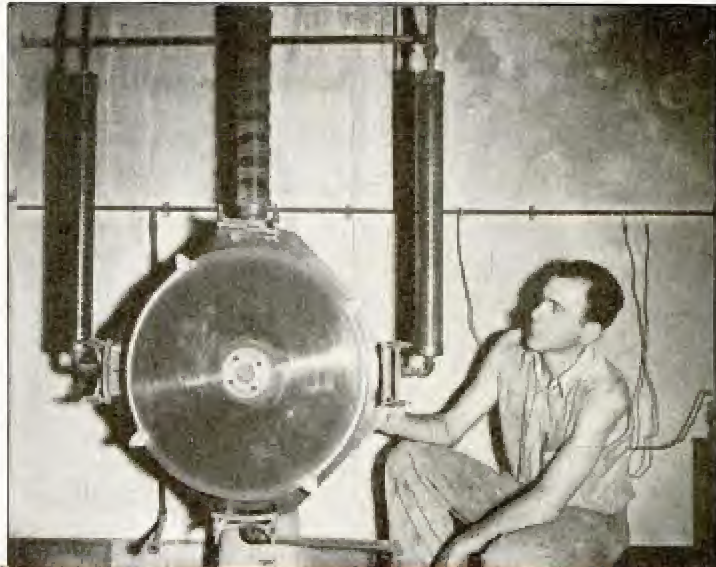
Lead and zinc smelters are finding an additional source of profit in their chimneys, in the form of tons of cadmium and bismuth that had been going to waste. Many copper companies have learned to extract sulphuric acid from their chimney fumes, the sulphur being

Reg: Western Precipitation Corp
1016 W 9 St, Los Angeles, Calif

RICHES *from* SMOKE

ally packed with money and that all that needs to be done is to reach out and collect it. Thousands of tons of valuable metals that otherwise would be lost forever are being saved every year. It is estimated that as much as one percent of our national production in gold, silver, copper, lead, zinc and cadmium has floated away in the air.

The mechanical cyclonic collectors and electrical precipitators that retrieve these metals from smoke also perform many other kinds of



odd jobs. They are used to cut the cost of paper manufacture by recovering salt cake from the waste so that it may be used again. They clean dust from the waste gas of blast furnace stacks so that the gas may be used as fuel. They purify manufactured gas by removing tar, oil and water from it. They abate smoke nuisance by collecting cinders and dust from boiler stack gases. They help prevent silicosis and hay fever by removing irritants from the air. They are used in the processing of dried blood plasma, milk powder and dehydrated foods. They will even eliminate an objectionable smell escaping from an industrial chimney.

Aluminum that has been reclaimed from waste gas and smoke becomes a warplane part at one of America's busy aircraft plants





Determining amounts of particles of different sizes contained in chimney gases with a special apparatus

most of the suspended matter in the air against the wall of the tube, from where it drops into a collecting hopper below. Meanwhile, the purified air escapes through an exhaust and passes up the chimney. So-called "multiclones" that consist of great banks of such tubes are handling and cleaning tremendous quantities of industrial gases today. The tubes may range from three inches to several feet in diameter.

The multiclones are up to 97 percent efficient and collect airborne particles that may be as small as three or four microns in diameter. A micron is one twenty-five-thousandths of an inch. Such tiny bits of matter will pass with ease through the finest commercial screen. A screen of 400 mesh, for instance, so fine that water won't

leak through it, only holds particles down to 30 microns in size.

But many valuable particles in smoke and fumes are smaller still. To collect these, or to insure virtually 100 percent collection of larger particles, an electrical precipitation method is used. Called the Cottrell method because of its



Left, "batching" bins at gold smelter for measuring amounts of ores and chemicals

Below, inspecting huge insulators above a transformer for big electrical precipitator

Essentially, all these processes are the same. Each consists of removing dust and suspended matter, possibly in the form of a fume or mist, from the air. The gold that made its way up the chimney, for instance, consisted of submicroscopic particles that floated up with the ascending gases.

There are several ways to trap such materials. One method employs a small artificial whirlwind that concentrates the dust by centrifugal force. On its way to the chimney, the waste gas and fumes are blown into a conical tube. Inside the neck of the tube are a number of stationary blades, the curved surfaces of which impart a whirling motion to the oncoming stream of air. This whirling motion forces



development by a University of California professor by that name, modern electrical precipitation is an outgrowth of one of the first "magic tricks" that was performed with the aid of static electricity. Nearly a century ago it was observed that, when a wire that is charged with static electricity is plunged into a jar of smoke, the smoke vanishes instantly. All of its particles fly to the side of the jar and the air becomes transparent.

This phenomenon has been put to work. Today a dense industrial smoke, on its way to the chimney, first flows through a precipitation tube. A discharge electrode connected to one side of a high voltage rectifier is suspended inside the tube, the wall of which is grounded. When the current is turned on, all the particles suspended in the air inside the tube are ionized and are precipitated against the wall of the tube. The material builds up in the form of large flakes. From time to time the tube is hammered to knock all the collected material into a hopper below. The effect is miraculous when this apparatus first goes to work. Dense clouds of smoke that are billowing from a chimney instantly disappear when the current is turned on.

You can blow puffs of cigarette smoke into one end of a small Cottrell demonstration cylinder, yet no smoke issues from the other end. Nothing escapes except invisible gases such as carbon dioxide and nitrogen. All the visible ingredients of the smoke are precipitated inside the tube as small amounts of tar and white ash.

An electrical precipitator can't collect matter that is in a gaseous state. This fact is taken advantage of in the gold refinery. At one stage in the refining process the ore must be roasted and the heat of this action releases a quantity of arsenic that the ore also contains. Animals and humans in the area would be poisoned if the arsenic escaped up the chimney. So the gases, at 450 degrees, first pass through a multiclone collector that extracts the submicroscopic gold particles and other dust. At this temperature the arsenic is a gas. Next the gases are cooled down to 250 degrees, condensing the gaseous arsenic into a fume of tiny solid particles. The next step is through a Cottrell precipitator that removes every trace of suspended arsenic, and the "purified" gases that remain then travel up the chimney.

(Continued to page 171)

JANUARY, 1943

'Standisit' Seats in Street Car Increase Its Capacity



More of these seats can be crammed into car or bus

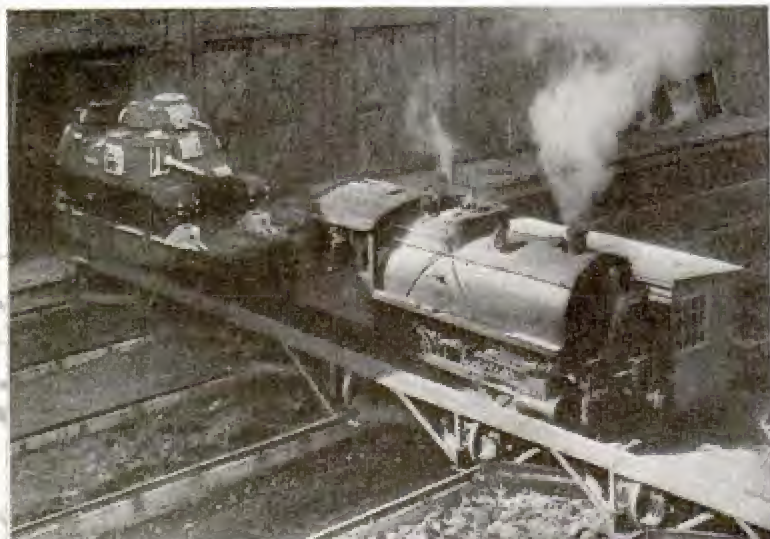
Seats for street cars and buses that pose passengers in half sitting and half standing posture are being tried on Washington, D. C. commuters. Called "standisit" seats, they are placed only 18 inches apart, being 10 to 14 inches closer together than usual, and it is said they will increase "seating" capacity from 25 to 40 percent.

Batteries Lose Charge Faster When Temperature Is High

In storing your car it would be best to find a cool place for it, because at 100 degrees Fahrenheit the idle storage battery loses its charge three times as rapidly as at 70 degrees, but at 32 degrees the loss is vanishingly small. Tests carried out by A. C. Zachlin in the laboratory of Willard Storage Battery Company showed that the average automobile battery when idle loses about one percent of its charge per day, so in three months it would be virtually discharged. Batteries with plates of pure lead, it is explained, have practically no loss on standing—about 15 percent a year. But pure lead being too soft for auto batteries, it is customary to use lead containing six to 12 percent antimony.

Development Laboratory Detroit, Mich.

Tanks Roll From Birthplace of Pullman Cars



828
Headed for some war front, a medium tank moves out on a transfer table at a Pullman-Standard Car Manufacturing Company plant

All-welded tanks went into production immediately after these riveted tanks—the last of a big order for the British—had rolled away
↓

What was once an arsenal of American railways has become an arsenal of war. Tanks roll in swelling volume from the Pullman-Standard Car Manufacturing plant that turned out sleeping cars and box cars for peacetime transportation. A huge order for M3 medium tanks for the British army had hardly been completed when Pullman turned from these riveted models to build new welded tanks for the U. S.



Army at eight times the previous production rate. And tanks are not all. Its experience in building aluminum streamline trains was put to use in fabricating wings for army transport planes on a large volume basis. Artillery shells in four sizes are a major item. Pullman workers machine them, ship them to government shell-loading plants to receive their deadly charges. Trench mortars are another article coming

from the erstwhile car factory—81 millimeter mortars that accurately lob high-explosive shells on targets a mile away. More closely related to the peacetime product is the freight car being built for the U. S. Army. Shorter than the standard box car, it has only four wheels instead of eight. Other items on the company's repertoire are howitzer carriages and weldments for antiaircraft gun mounts.

Wood Made Fire-Resistant by Secret Low-Cost Process

Tremendous possibilities in preventing fires—of extreme importance in time of war—are predicted for a fire-resisting chemical compounded recently and developed by Dr. Walter Juda under the direction of Dr. Grinnell Jones, at Mallinckrodt

laboratories, Harvard University. Unlike a mere surface paint, the fluid, known only as F. A. M., impregnates the wood so thoroughly that it becomes as difficult to burn as hardened steel. In actual incendiary bomb tests, treated wood panels only be-

came charred under circumstances that destroyed untreated wood. In some instances, when the terrific heat was closest to the treated wood there was momentary ignition, but F. A. M. put out the fire in a few seconds and resisted further burning. The formula is a guarded secret, but the ingredients are relatively inexpensive and not difficult to obtain. It is a dark blue water solution of certain chemical salts, having a faint odor of ammonia, and has an affinity for cellulose fiber so it will penetrate wood when sprayed without the customary expensive process of vacuum and pressure. As to other advantages, it is easy to apply, safe, leaves no unpleasant odor, it does not weaken wood fibers, nor absorb moisture.

Gunner in "Belly Bubble" Bags Many Fighters

To take his station in the "belly bubble" of a Flying Fortress, a gunner must worm feet foremost through a small doorway. His cramped roost, one of the most uncomfortable positions in the huge bomber, is also one of the most effective against enemy craft. Curled up inside the "glass blister," the gunner often somersaults during combat, firing a .50 caliber gun between his feet.



Gunner curling himself into "belly bubble" to man bomber gun

JANUARY, 1943

Outdoor Feeder for Small Birds Closes Door on Squirrels



Feeder (top) is open to bird, but shuts for squirrel (bottom)

Only small birds can get food from a clever bird feeder that stops larger birds, such as pigeons, and small animals such as squirrels, when they attempt to steal the food intended for their smaller neighbors. The feeder remains open as long as only tiny birds alight on the perch to help themselves from the dish which is breast high. But let a squirrel or pigeon, or other large bird, get on the crosspiece perch, and its weight forcing it down will close the lid. In raised position the lid, which is supported on a sleeve rod and held up by a coil spring, helps keep snow and rain from falling on the food.

Carson Pirie Scott & Co.
State & Monroe
Chicago, Ill.

Allen Media Office, 7 Park Ave N.Y.C.

ALUMINUM GOES TO WAR

7/8/43



Aluminum machine-gun turrets for bombing planes are now formed by a powerful press formerly used to stamp out halves of aluminum beer barrels

WHEN aluminum was graduated from the kitchen into such diverse applications as streamlined trains, skyscrapers, ships and barrels, public interest in this versatile metal became very keen. Now that aluminum has changed from civvies to a uniform, its life story takes a new twist.

The man on the street and the woman in

the home hold no grudge against the metal for being so scarce for them now, but want to know how this scarcity came about, and when they can use aluminum again.

There is no hope for aluminum's early return to civilian life. The tremendous expansion in the industry is entirely reserved for the gluttonous needs of war. And so news about aluminum right now falls into three categories: (1) what amount will be available when the expansion program is completed, (2) where it is being used in the war, and (3) what plans are being made for it when peace comes.

In normal times—let's take 1936 as a normal year—only a third of the

aluminum used in this country was newly produced by the American industry. Another third was imported, and the final third came from the scrap pile.

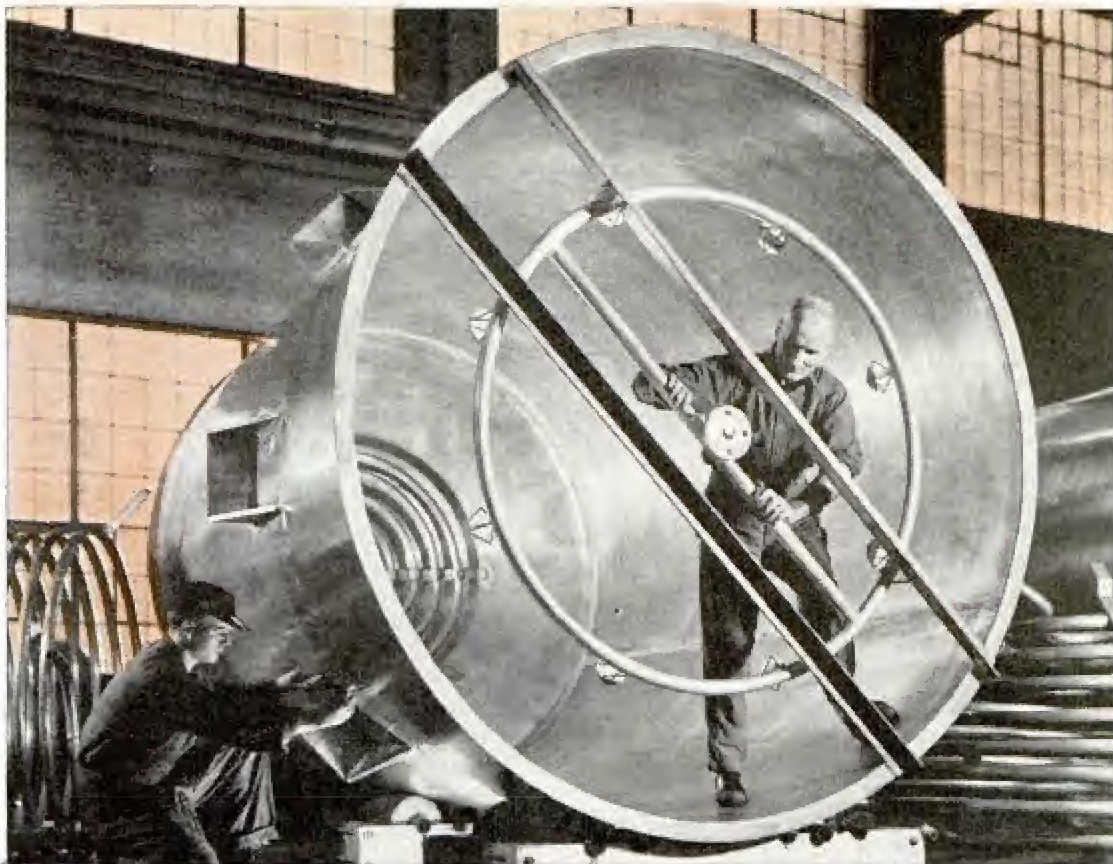
Thus, if our country consumed three quarters of a billion pounds of aluminum annually, there was only need for a capacity of 250 million pounds of virgin metal.

Workmen machine-spinning large aluminum container



Rolling paper-thin aluminum foil to wrap your food





R. G.

The Aluminum Company of America, then the sole producer of aluminum in the United States, had this capacity, and more, but was never called upon to deliver more than this amount until 1937.

By 1937, considerable industrial activity was going on, particularly in the aviation industry. Since about 90 percent of the weight of an airplane is aluminum, this meant the aluminum industry had to prepare for a general expansion. The Aluminum Company began an expansion of its plants, and this program, including many additions since 1940, is costing the company more than \$215,000,000. The program is now virtually completed, and other companies are also adding to America's aluminum pile.

Our production in 1937 was about 300,000,000 pounds. In 1940 the figure stood at 412,000,000 pounds. But the national defense program was setting a fast pace. The aviation companies needed metal, and needed it quickly. And the aluminum industry was up to the task.

Here is a job for a war industry—an aluminum processing tank

Pittsburgh, Pa.
Soldier of the home front works with aluminum casting alloys





Powder containers for 15-inch shells are of aluminum



Aluminum heat exchanger stands 900 pounds pressure

Airplane manufacturers were supplied with all the aluminum they needed.

Aluminum had to fight its way into practically every field but that of aviation. There it was a "natural." It had the required strength and lightness, and right from the beginning it was the favored construction material. The success with which aviation crowned aluminum soon spread to other fields—streamlined trains and ship structures, machine tools and automotive pistons, racing cars and shovel dippers.

The Aluminum Company's expansion gave the country a number of new plants,

additions to old ones, and new machinery with which to fabricate aluminum products faster and better. In one instance a new sheet rolling mill built in one of the older plants turned out aluminum sheet 50 times as fast as it was ever rolled before! A new sheet plant with a similar rolling mill was erected near this particular plant with a capacity of millions of pounds of sheet monthly. This plant is perhaps the largest building in the world, with 55 acres under roof.

By midsummer 1941 it was obvious that no company could finance the projects needed to bring the production of aluminum to the point desired by the nation's leaders, and the Defense Plant Corporation was organized. The Aluminum Company is building 15 plants for DPC, and with its own program, 35 major projects are now under way.

By the end of 1943, the United States production of aluminum will be approximately 2,100,000,000 pounds—about seven times its 1939 production.



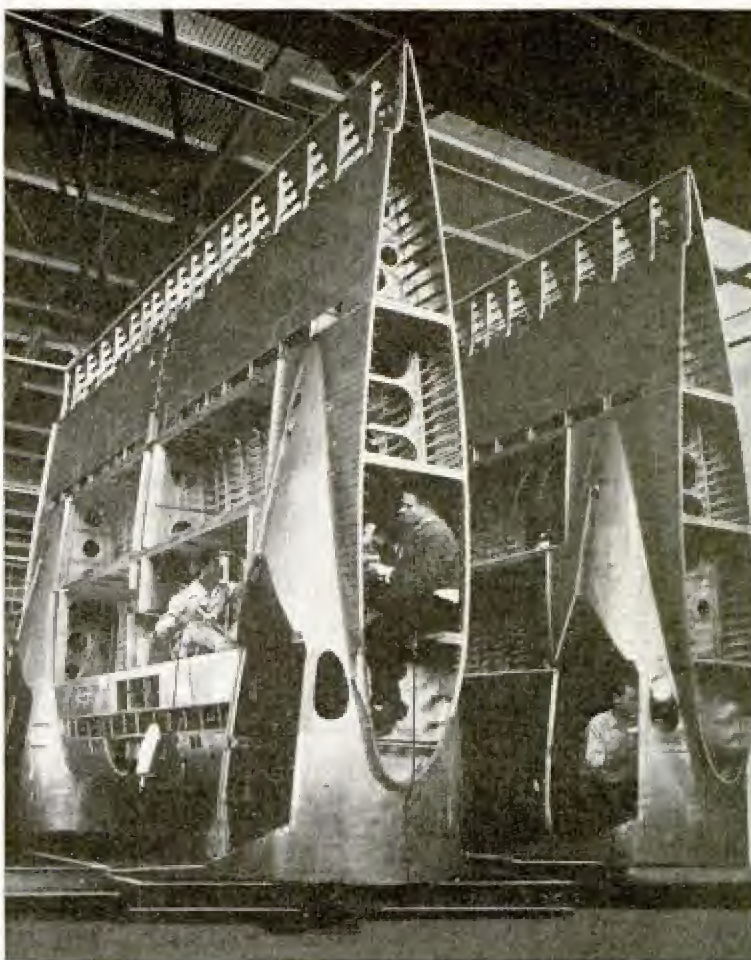
Every aluminum rivet for planes is inspected before shipping

Several of the new plants will each produce more aluminum than the entire nation made at its World War I peak—yet there won't be a pound available for civilian use.

Two billion pounds of aluminum is a lot of metal. It means that a lot of electricity will be required to make this metal, for a pound of aluminum takes as much electricity as is needed to light a 40-watt bulb for a week and a half. When this huge annual capacity is an actuality, more than 7,300,000 pounds of aluminum will be made each working day, and this will require more electrical current daily than a city of 60,000 homes consumes in an entire year.

Since aluminum needs so much electricity, it has always been the custom of aluminum companies to find this electricity where a plentiful supply of water power is available, as in the Tennessee valley. The Aluminum Company of America had three power dams at the outbreak of the war, and added two more in the past year. But these take time to build, and large metropolitan areas usually have great amounts of power available, although it isn't as cheap as water power.

Since Hitler won't wait, it was necessary to locate new aluminum plants near large power sources. The largest aluminum metal-producing plant in the country is now under construction in the New York area. Another, using natural gas to generate power, is being erected in Arkansas.



Sheets, rivets and extruded shapes used in our big warplanes are made of aluminum. Above, wing sections and engine nacelles are being installed

Aluminum that once went into cooking utensils now makes army mess kits



Wanda Hancock



↑
Installing the conical bottoms on a battery of oil-processing tanks—aluminum serves the chemical industry

→
If you have trouble buying an outboard motor, remember these aluminum motors are used for assault boats

↓
Aluminum disks once shaped into pots and pans are now the beginnings of reflectors for army-navy searchlights



Incidentally, quite a bit of copper bus bar is used in aluminum metal-producing plants. Since copper is also scarce, and since silver will take its place as a conductor (as a matter of fact, it's better), the United States treasury will loan the DPC aluminum plants silver for their bus bar. Present plans call for 13,000 tons—about \$200,000,000 worth! At the conclusion of the war this silver will be returned to United States vaults.

Before the Aluminum Company began building for the government, it was decided to standardize buildings and equipment as much as possible to complete the construc-



tion program quickly. This decision paid big dividends. For example, 175 cranes, of the same span and capacity, were purchased from one manufacturer, who was able to set up a production line and increase his efficiency. Seventy-two buildings came from one set of shop drawings.

And now a word as to where all this aluminum is used in the war program. Most of it goes into airplanes, but there are literally hundreds of other uses vital to victory. In the army these include aluminum mess kits, cups, steam-jacketed kettles, mobile field kitchens, anti-aircraft searchlight housings, searchlight cradles, gun battery director housings, gun platforms, direction finders, shell fuses, "walkie-talkie" antennas and cases, relief maps, pontons, trestles, camera and radio housings, and outboard motors.

In the navy, aluminum is used for coffee biggins, stock pots, beating bowls, steam-jacketed kettles, baking and roasting pans, bread and muffin pans, chairs, tables, cabinets, trim and molding, electrical fixtures, pipe berths and lockers, fittings, bus bar, screws, nuts, rivets, bolts, wire and rod, structural applications. Several more military uses are secrets and cannot be told.

But there won't always be an army and a navy of the size we have now. Some day swords are going to be beaten into plowshares and spears into pruning hooks. What's going to happen to the vast aluminum production that has been built up? Will it collapse and throw thousands out of work?

A great number of people in the industry believe the day of aluminum is only beginning to dawn. For one thing, the price is now 25 percent lower than it was only a few years ago. This in itself is going to bring in great numbers of requests for the light, versatile metal.

Furthermore, the public demand for replacements is going to keep the aluminum mills busy for some time after the war. There'll be a great need for new washing machines, vacuum sweepers, refrigerators with their aluminum trays, and countless other items.

Then, too, many things that were newly developed had scarcely reached the public when the war started. Wide applications of aluminum in architecture are about 12 years old, yet this field has barely been touched. One of the newest developments is the aluminum window for private residences: it is efficient, permanent, easy to handle, and presents no problems of maintenance.

The first all-aluminum streamlined train made its debut in 1934. Since that time, about a dozen all-aluminum streamlined trains have been built and are now in service. Their performance made a tremendous impression on railroad officials, and they no doubt will be forerunners of a great number of other aluminum trains.

In addition, more aluminum will be used in freight equipment. Some very thorough tests were made, both in the laboratory and in service, on coal and sulphur transportation. Sulphur attacks steel rather rapidly, but has no effect on aluminum. Coal contains a certain amount of sulphur, which has been a problem to railroad people in

(Continued to page 169)

JANUARY, 1943

*Sonoco Products Co.
Spartanville, S.C.*

Paper Molds for Concrete Speed Pier Construction



Sawing a tube to required length for building pier

Fiber tubes that can be sawed quickly to required lengths are being used as forms for concrete piers on war building projects. The tubes are spirally wound to give strength and waxed to prevent absorption of water. After the concrete dries, the tubes can be cut away immediately or left until the building is completed.

"Cat's Eye" Meter Gauges Glow Of Sky on Darkest Night

Now that "sky light" aids enemy submarines off shore, its intensity at night is of vital concern. A super-sensitive photometer developed by General Electric measures down to one twenty-fifth of the light from a moonless sky on a clear night.



Measuring sky glow with super-sensitive photometer

*A. H. Taylor Research
Scientist G.E. Co., Nela
Park, Cleveland, Ohio*

PLANT BEANS MONDAY---



Chinese bean sprouts, traditional ingredient of chop suey and a tasty addition to a dozen other dishes, can be grown in your home in three days without sunshine or soil. A 10-inch flowerpot, piece of cardboard, bucket, homemade rack, and cheesecloth are required. First step, left, pouring Mung beans into lukewarm water to soak for 10 hours. Right, cheesecloth is placed in bottom of the flowerpot, then beans are poured in and covered with several layers of cloth

Three days later, below left, the green pellets have become vitamin-rich sprouts two or three inches long and ready for harvesting. This operation, right, includes cutting remnants of bean from the sprout. Then it is ready to be served raw in salads or as a relish, cooked and served hot—either fried or boiled—alone or in combination with other vegetables such as corn or onions. Mung bean sprouts have been grown by the Chinese as a table delicacy for 4,000 years



Cont. R. DeWitt Miller, 457 So. Lurand Ave., Los Angeles Calif.

EAT 'EM THURSDAY



Above, placing cardboard over top of pot after "planting" to assure total darkness. This also helps hold humidity as well as keep light from beans which would induce an undesirable leaf growth. The flower-pot is supported by cleats across the top of simple homemade rack shown at right. This rack is of convenient height for watering and the galvanized pail under it catches water as it drains through pot. About a quart of lukewarm water should be poured over the beans every four hours, except at night. Bean sprouts will develop with only one or two waterings daily, but frequent moistening hastens the harvest



Left, tipping pot and placing small block under it allows oxygen to escape if this farming project is attempted on sink or other flat surface without rack. If the container is set flat no oxygen can escape from the hole in bottom

*Wizard Specialty Co
6106 W. National Ave
Milwaukee, Wis
m 684*

Wire Cage Protects Tube In Test for Slow Leak



"Caged" inner tube safely withstands high pressure

Slow leaks in inner tubes are detected quickly and safely with a wire cage that permits tests under high pressure. The deflated tube that has been causing trouble is inserted in the framework of galvanized wire and then inflated. Pressure can be increased until the leak is revealed without danger of bursting an old tube.

Field X-ray for Combat Planes Saves Dismantling Ship

Within 15 minutes after a warplane lands, structural damage sustained in bat-



Stepping into darkroom of the compact X-ray trailer

tle is revealed by an X-ray trailer laboratory without dismantling the ship. The completely equipped unit is wheeled out to the plane and X-ray exposures taken right on the field. Then the operator steps into the darkroom within the trailer and develops the negatives. If any hidden damage is detected, the plane is grounded; if not, it is pronounced fit to return to battle without delay. The laboratory is self-sustaining with power supplied by the towing truck. The compact unit, called the "Tear Drop" trailer by its inventors at the Lockheed Aircraft Corporation plant in Burbank, is about 13 feet long and weighs 4,000 pounds. It can be towed at 45 miles per hour and can go over rough country when dual wheels are used. The X-ray machine works automatically and is operated by one man.

Bulb Planter Digs Hole Quickly By Lifting Square of Dirt



Scooping out holes or trenches for planting bulbs is eliminated with a digger that removes just enough earth to form planting holes of uniform depth. The tool is pushed into the ground and when lifted removes a square of earth. After the bulb is set, the dirt is discharged from the planter to fill the hole by pushing down on a lever on the side of the handle.

Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

POPULAR MECHANICS

*Dr. Tom T riplett + Barton
Labs. Burbank, Calif*

*80 Dr. Tom T riplett + Barton
Labs. Burbank, Calif*

One-Man 'Chute Boat Inflates in Ten Seconds



Boat pack, left, tilts scale at 12 pounds. Right, inflated, it cradles pilot and a few needed items

Flyers in our armed forces are receiving new one-man rubber parachute boats which can be inflated in less than 10 seconds in the event their ship is forced down over the water. The collapsible lifeboat, made by United States Rubber Company, is attached as a seat pack to the fighter pilot, who also wears a life vest. After alighting upon the water, the pilot opens a valve on a small carbon dioxide cylinder,

and in five to 10 seconds he has a seaworthy craft five feet six inches long and three feet four inches wide. Deflated, it folds into a bundle about 15 inches square and four inches thick. The boat, with its 11 items of equipment, weighs 12 pounds. Equipment includes paddles, a hand pump to maintain pressure in the supporting tubes, a collapsible bailing cup, collapsible sea anchor, can of water and sea marker.

Rockefeller Center, N.Y.C.

Rescue Raft for Fallen Airmen Is English Channel Refuge

Many of Britain's sky fighters owe their lives to rescue rafts moored at various positions in the English Channel. A pilot of the Royal Air Force who may be forced down in the vicinity of a raft, finds in it a refuge for himself and crew wherein are stored bunks, radio, food and medical supplies adequate until a rescue plane or launch can pick them up.

One part castor oil and one part ethyl cellulose is the composition of a new plastic used as a rubber substitute in gloves, hose, gaskets, galoshes and other articles which do not need the "bounce" of natural rubber.



Haven anchored in English channel shelters fallen airmen

announced by
JANUARY, 1943

81

Send! John W. Harrington, 250 W. 42 St. N.Y.C.

HEROES of the TANKERS



With orderly speed the crew of a tanker rushes to assigned boats during one of the lifeboat drills at sea

HEROIC figures of this Second World War are those who in triple jeopardy of tempest, flame, and foe man the oil carriers which feed the Lamps of Liberty.

Ready always to pass through their ordeals of fire and water, hundreds of these tankermen have survived U-boat attacks and come back only to go down again to the oily deep. When we thrill to their grim tales of peril and privation, they shrug

their shoulders and say, "It's nothing much when you get used to it. It's the first time that gets on your nerves."

The tanker is a petroleum paradox. Those on board feel danger at hand, while enjoying comforts and even luxuries comparable with those of first class ocean steamships. If they are hurled into icy seas or lakes of burning oil, or are doomed to drift for days on shattered lifeboats or frail rafts, they accept the fortunes of war as do veteran soldiers.

Although taking so active a part in supplying to the Allies the fuel of war, tankermen are not under the urge of formal enlistment. They still rate as private citizens. They are almost in the army and navy yet not of it. The movements of the huge oil bearers are practically under the direction of the



Navy gunners aboard an oil ship practice handling their gun for quick action against submarines

United States Maritime Commission, which has supervised the building of many of them.

Tankermen are especially fitted for the important role they now play in the world crisis, for their ordinary peace tasks require much of the same vigilance and discipline as are expected on a ship of war.

Tanker life is different, however, from any other life on the surface of the sea—or under it. Its character is largely due to the peculiar construction and functions of the tankers themselves. Their cargoes are stowed in tanks in the holds separated by stout bulkheads of steel. All inflammable petroleum products give off gases, especially in transit. The compartments of a tanker, therefore, are well ventilated by pipes and valves which convey the rising vapors well into the outer air. In some units hollow masts, in which there is a flame-arresting appliance, furnish outlets. Each minor tank has its own hatch, the curb or coaming of which rises three feet above the steel deck, the cover being clamped down tightly by numerous heavy gaskets of metal.

Caution is the officer of the day. Gas is a will o' the wisp. It is likely in certain weathers to drift down to the hull; perhaps it may be in a thin layer as high

Photo from Tankers Corp.

Tankers have their engine room, funnel and galley aft to keep all heat away from inflammable cargo



Radio silence is observed in a convoy but the tanker's operator (above) is always listening. Below, guards always keep strict watch against fire hazards while loading

Socony-Vacuum photo





Photo by Wendell MacRae from Texas Co.

The Officer of the Day makes observations as ship plies perilous waters

as a man's mouth, although his nose ought to be aware of it. Hence, the cardinal rule against smoking on deck or in the working parts of the ship, proclaimed on all tankers, in six languages. Even in normal times fire and explosions of collected gas must be guarded against with utmost precaution.

In warm weather, sun heat or rising temperatures may cause explosions of freed vapors. Therefore, the decks are frequently flushed and the scuppers kept partly filled with water.

Even though a tanker be empty or in water ballast the "No Smoking" order obtains. After she has discharged her cargo her tanks are cleansed with live steam and whirling jets of boiling water. When the

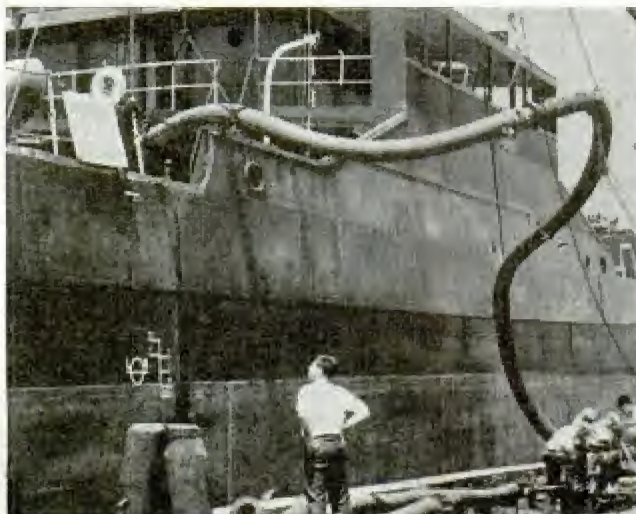
young geysers cease to spurt from her hatches men go down iron ladders into the compartments and scrub the walls clean. They do not do so, however, until chemical detectors indicate the space is reasonably clear of gas. As a tanker is being loaded, fire wardens patrol the adjacent docks and yards; all visitors are barred and everywhere cigarettes are taboo.

Further to checkmate fire hazards, the furnaces and engine rooms and even the galleys (kitchens) are placed far aft—not amidships, as in most steamships.

Against surprise from U-boats and Axis bombers, the precautions are still more elaborate. Day and night there are drills at fire fighting and abandoning ship. Navy gun crews swarm to their stations for gunnery practice. Aloft in the crow's nest, or on deck, lookouts scan sea and sky. The bow lookouts, being nearer the water, are more likely to spot submarine periscopes.

From his low position the submarine pilot can see the outline of a prospective victim silhouetted against the faintest glow. Hence the strict "dimming out" of lights along the sea coasts. In sunshine the tanker is a vague shape in drab paint or camouflage. Perfect combustion in her furnaces leaves no telltale column of smoke by day

Left, loading a tanker's touchy cargo through canvas-rubber pipe. Right, the mascot at home on the bridge



nor pillars of fire by night.

Most crises come to oil carriers when fully loaded, as attacks on empties are comparatively rare. The zero hour is usually at dawn. Warships and cutters have been reducing the fatal toll steadily, while armed tankers are no amateur fighters themselves.

Their exploits will furnish many a stirring anecdote after the war. One of the oil fleet, struck amidships by a torpedo, began to settle. Before she sank, her gunners planked a shell in the conning tower of the enemy sub. The tankermen adrift in lifeboats saw the oil slick beneath which the underseas marauder had gone to her doom.

Tanker casualties run highest where the torpedo has pierced the engine room, or an incendiary shell has entered a laden compartment.

Escape is then likely to be handicapped by the blazing oil which spreads over the waters. Many have come out alive by diving and swimming beneath the inferno.

In winter there is the peril of freezing in the icy waters. Among the new protectives are buoyant suits of heavy fiber which combat heat and cold.

Tanker men who have had most harrowing experiences are always ready to go to sea again, when physically able. Once they have had their baptism of fire they become seasoned veterans. They are getting double or bonus wages (\$200 a month) and insurance, yet underlying their service is a patriotic motive.



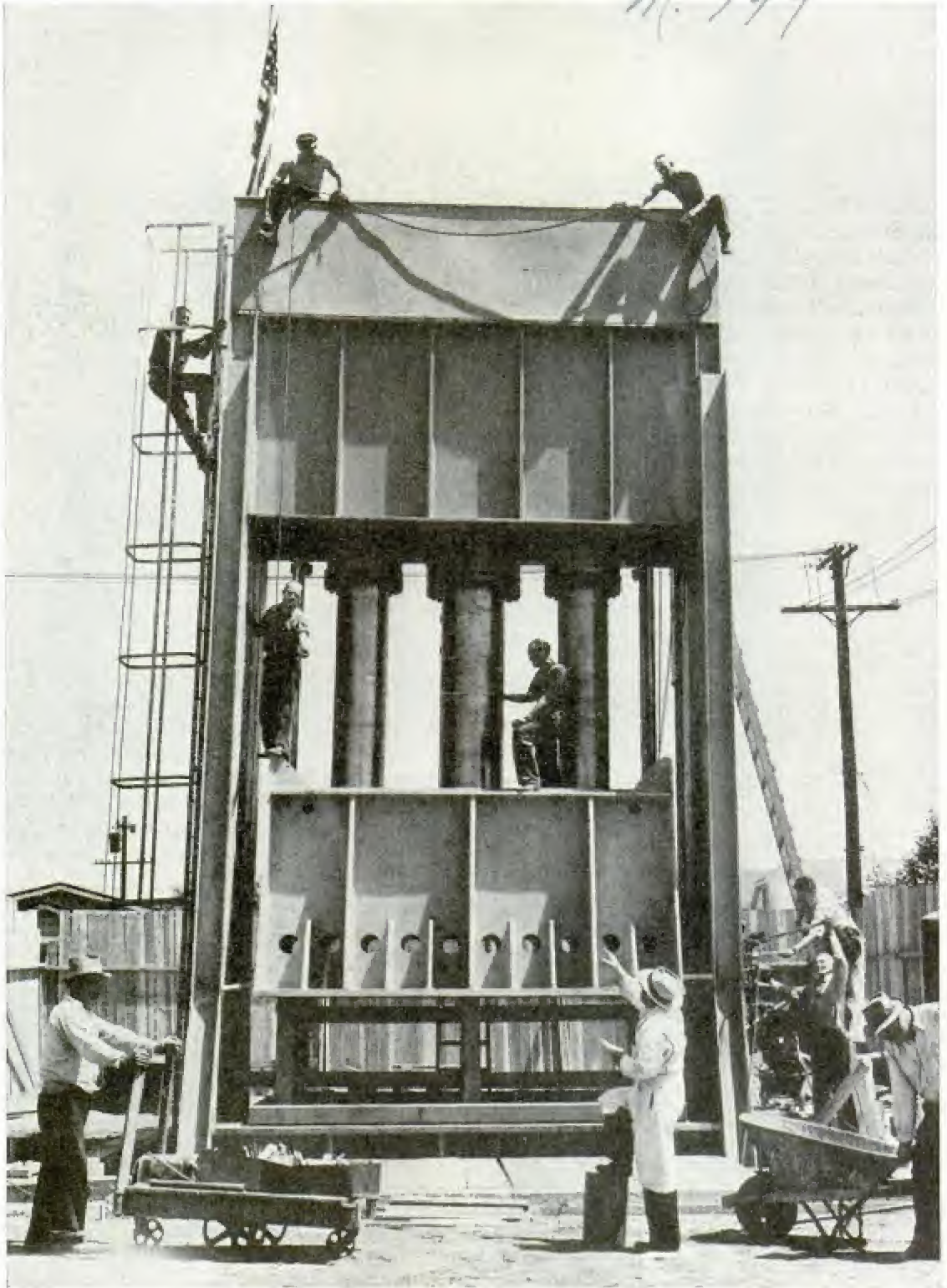
The crew knows every lifeboat drill may be rehearsal of grim reality. Lifesaving suits carry bottled water, flashlight and concentrated food

The men behind the gun are always on the alert, and they are winning duels with attacking submarines more often than can be told officially
U. S. Navy photo



210-Ton Press Speeds Building of Cargo Ships

M. 799



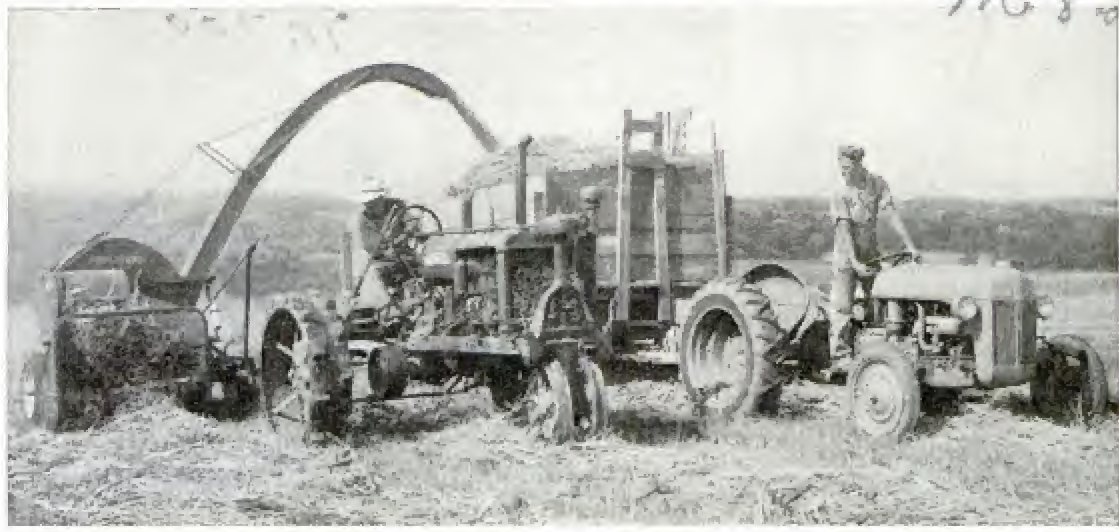
Production of cowl ventilators for America's new Liberty cargo ships is being speeded up with the world's largest die stamping press. It stamps out ventilators eight and one-half feet high and six feet in diameter with two strokes of its huge pistons. The halves are welded together in one operation. The press weighs 210 tons, has a pressure of 1,100 tons, moves downward at a maximum speed of five feet per minute and rests on a 390-ton concrete foundation. It was made by the Weber Showcase and Fixture Company, Los Angeles

Wm. P. Smith.
Res. Engr. for

Deere & Co, Moline, Ill.

Machine Cuts Up Hay and Blows It Into Wagon

m 837



Making hay with new type loader saves manpower with cutter and blower which elevates it into the wagon

Hay is picked up from a windrow and chopped into short lengths by a new type of cutter that also blows it into a wagon box. The machine, which is pulled by a tractor, cuts hay or straw into lengths that can be varied by adjustment of the cutter

blades. It is operated by half the crew required to run a baler in the field. Harrison Kell, a farmer near Rock Island, Ill., used the machine for cutting and loading and then blew the hay from the wagonbox into his barn with an old grain separator.

acme Newfictions Inc. 461-8

Grain Is Fumigated in Storage Tanks With Liquid Spray

m 772

Liquid that evaporates quickly into a heavier-than-air poison gas is being used to fumigate grain in storage tanks by a method recently developed by federal and state entomologists. As the gas is poisonous to man as well as to grain insect pests, only a trained operator should be permitted to do the spraying and should always be protected by a gas mask covering the entire face.



W. H. Wackstein U.S. Dept of Agriculture

Concrete Manhole Fittings Save Iron for War

m 954

At a saving of a great amount of iron, manhole fittings are now being made of reinforced concrete. The concrete unit requires only about 30 pounds of metal, whereas 350 pounds of iron went into the all-metal type. To build strength into the new cover, which weighs less than 100 pounds, an inverted truss design is used for the welded reinforcing.

Liquid spray turns into gas quickly, so fumigator wears mask

JANUARY, 1943

W. E. Dunn Mfg Co. Holland, Mich.

Allen Warren Elliott, 7 Park Ave N.Y.C. LIFE GOES ON m 709

Photo by Cooper Union Art School, N.Y.C.



If human activity ceased with the wail of air raid sirens you wouldn't have a worry about blackouts. But it doesn't and you do. The degree with which a family or nation surmounts blackout problems and carries on "as usual" might be a measuring stick for morale. The young man, above, is making use of the "blackout bathroom" which no home should be without. The window is covered with a blackout curtain nailed to wooden strips. Decalcomanias on curtain lend colorful touch. To the left, Junior is all set for the duration with a handy "kangaroo" pouch that will keep him close to his mother while her arms are free to do her work. It's slung over the shoulder



Above, packetbook for blackouts has red reflector buttons, contains first-aid kit. Left, royal blue sateen curtains tucked inside decorative frame at kitchen window

BEHIND *the* BLACKOUT

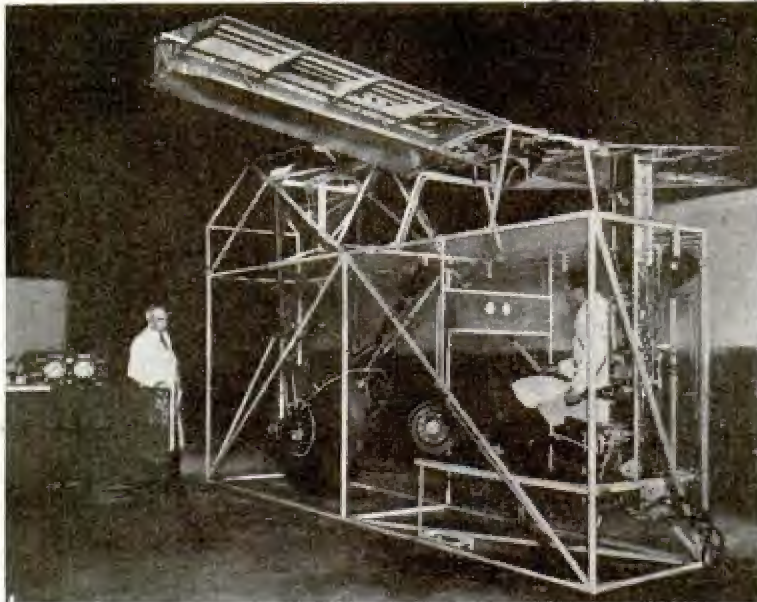


Any light bulb can be converted to a valuable blackout lamp with shields designed for special purposes. Those shown above were designed by Donald Wright of Pratt Institute, Brooklyn. The one at the left provides safe illumination for aisles and the cylindrical shield is for stairway lights in schools, homes or office buildings. Made of fireproof cardboard or dark glass, the shields fit over a 15- or 25-watt bulb and may be used in ceiling fixture, wall bracket or lamp. The boxlike shield, upper right, attached to a floor lamp makes it possible to black out windows with ordinary shades. Right, window blacked out with six layers of newspaper



Left, "bridge as usual" is motto of this foursome when the air raid sirens sound. The large window in this room can be blacked out quickly by lowering the Venetian blinds and drawing together blackout curtains concealed behind regular window hangings. Curtains are made of saten and they button down middle. Dark red, deep blue and brown curtains are as effective as black

Hydraulic "Nerves" of Airplane Bared in School's Mockup



Student-made mockup of the hydraulic system of a Douglas DC-3 reveals hidden parts of finished airplane at the Boeing School of Aeronautics

Students at the Boeing School of Aeronautics study the hydraulic system of a Douglas DC-3 with a mockup they built themselves. It reveals many of the parts concealed in a finished plane. A welded frame of hollow steel tubing was made in the welding shop, special fittings and machined parts were furnished by maintenance students, and the hydraulics shop completed the assembly with retractable landing gear, wing flaps, engine cowl flaps, power brakes and mechanical and electrical warning devices. Airplane mechanics must acquire a knowledge of hydraulic systems because control surfaces on large planes require hydraulic pressure rather than manual operation.

Television Aids Lost Pilot In Thick Weather

Fliers will be able to see through fog or haze with a television receiver that instantly converts infrared images sent by wire into visible pictures. Previously, infrared or long-wave light rays, which penetrate where ordinary light will not, have been used for making photographs from reconnaissance planes. A pilot who is

lost in a fog might make such a picture, but he would have no time to develop it. With the television receiver on his instrument board, all he has to do is turn a switch and the set picks up the infrared image formed in a television transmitter and sent by wire instead of through the air. This aviation aid was invented by Harold A. Adams, of Bakersfield, Calif.

Three-Wheel Chair Gives 90 Miles To the Gallon

To get the greatest mileage possible from her stinted gasoline supply under wartime rationing, a Newport, R. I. woman travels in a vehicle that is little more than a chair on wheels. Chauffeur-driven from the rear, the car carries passengers on a seat at the front. Its small engine pushes it 90 miles on a gallon of gas.



"Chairmobile," stripped of all non-essentials except the chauffeur, gives more miles on meager rations and helps save rubber

Herbert S. Macvaugh, U.S.N.

Double-Deck Diner Is Among Latest Patents

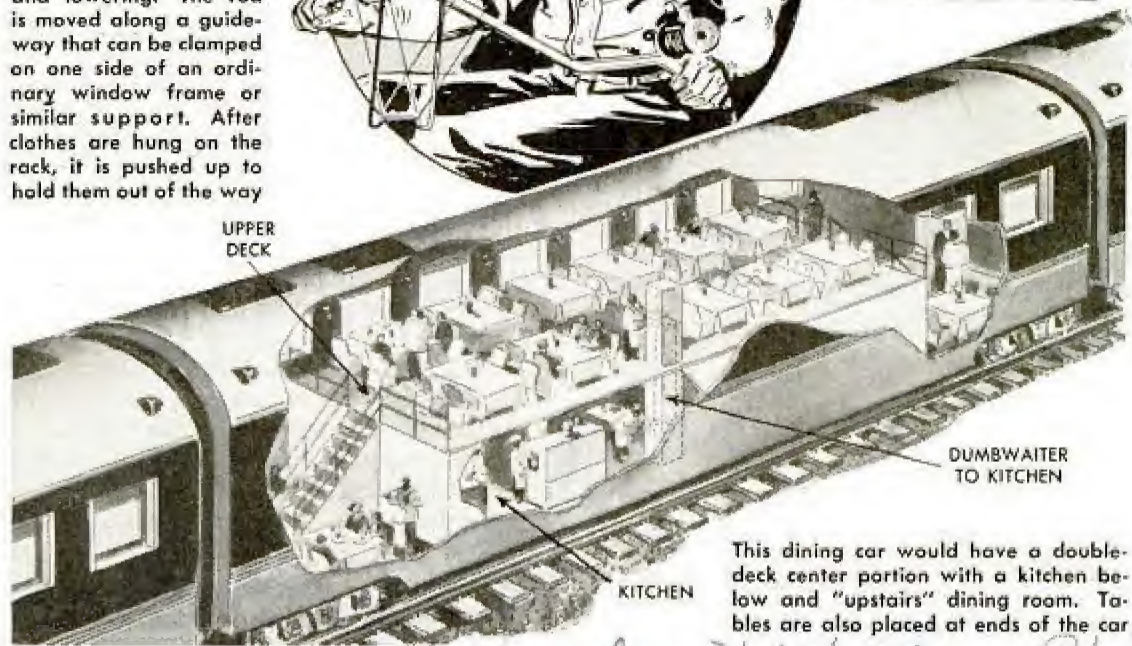
Among the latest inventions is a visor developed by a Navy man which protects the entire face of the sailor on watch and at the same time permits a clear forward vision. The sketch at right shows how extending side walls of the circular one-piece visor protect the face. Held in place by straps over the head, the visor takes the sting out of a biting northeaster whipping around the crow's nest and gives protection from the salt spray for men at deck stations



Above, a handy rack for drying clothes indoors is attached to a movable rod that permits raising and lowering. The rod is moved along a guide-way that can be clamped on one side of an ordinary window frame or similar support. After clothes are hung on the rack, it is pushed up to hold them out of the way



Left, a "spinning wheel" for fishermen that will enable them to dry their lines and avoid tangling them. It has a drying reel mounted on a frame with a crank to wind wet line off fishing reel. All of the articles on this page were recently patented, but no other information is available at this time for any prospective purchasers



This dining car would have a double-deck center portion with a kitchen below and "upstairs" dining room. Tables are also placed at ends of the car

Herbert H. Horton, Phila, assignor to the Phila. & Wm. Co. Phila, Pa.

Walter K. Harris, Richmond, Va.

*Charles W. Guenther, Cedar Rapids, Ia.
Donald C. Hawener, Marion, Ia.*



Sunlight is made to turn corners with mirrors and safely illuminate hundreds of feet of sewer conduits
Cleaning a clogged pipe with harpoonlike instrument



FLOWING under every one of our war production centers are great underground rivers. Few people have ever seen them. They would never be the subjects of romantic songs such as rivers often inspire, yet if anything stopped their flow the damage to our war effort would be equaled only by an aerial blitz.

These rivers are the sewage disposal systems, thousands of miles of main outfall, fed by literally millions of miles of tributaries. To "keep 'em flowing," to keep our war industries rolling, and to protect the health of the home front is the important job of a few skilled workers and technicians, armed with modern knowledge and scientific instruments.

Industrial wastes, such as have increased greatly in the last year or two, are the bane of sanitary engineers; domestic wastes are relatively easy to eliminate. Technological production gives off materials which cause chemical erosion, threaten explosion, clog outlets, and could, if uncontrolled, paralyze whole areas which support millions of people and vital industries.

It takes a lot of doing to prevent such a

Reuben F.
Brown

RIVERS FLOWING



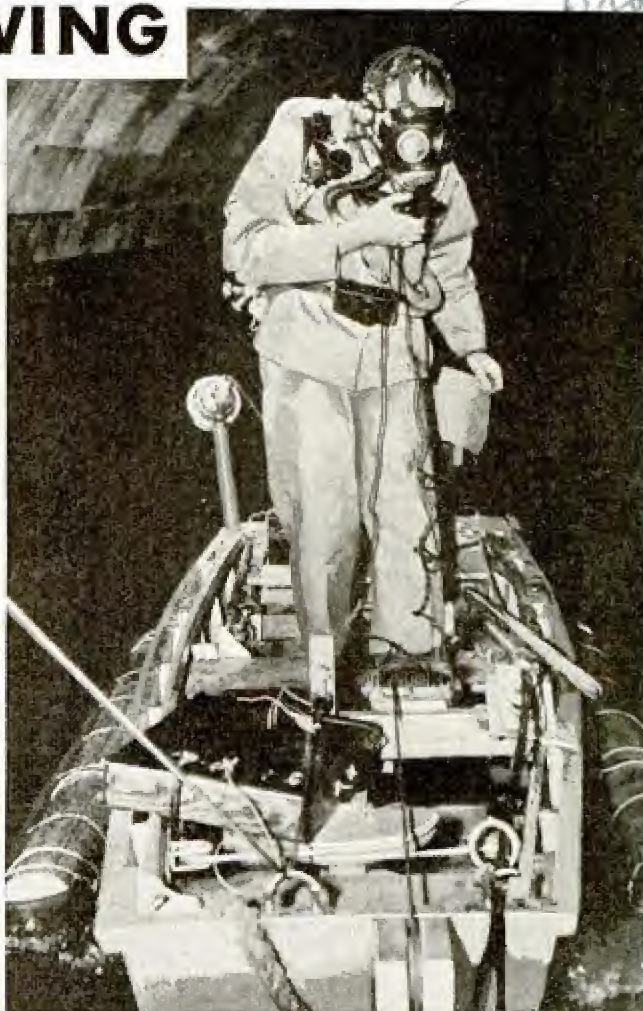
This eight-inch pipe was nearly clogged with a thick coating of industrial waste

major disaster. Men of the trouble shooting crews are often on the same 24-hour call as soldiers. In time of emergency, they must be equally prepared to plunge into hazardous situations. It's an endless defense program.

Take, for instance, the never-ending threat of chemical erosion. Some time ago, a spectacular survey of this condition was made by Reuben F. Brown, assistant superintendent of sewer maintenance of the Los Angeles Board of Public Works. On a small, specially constructed boat, equipped with a groaning load of testing paraphernalia, he made a trip the entire length of the city's 55 miles of giant outfall—largest of its kind in the world.

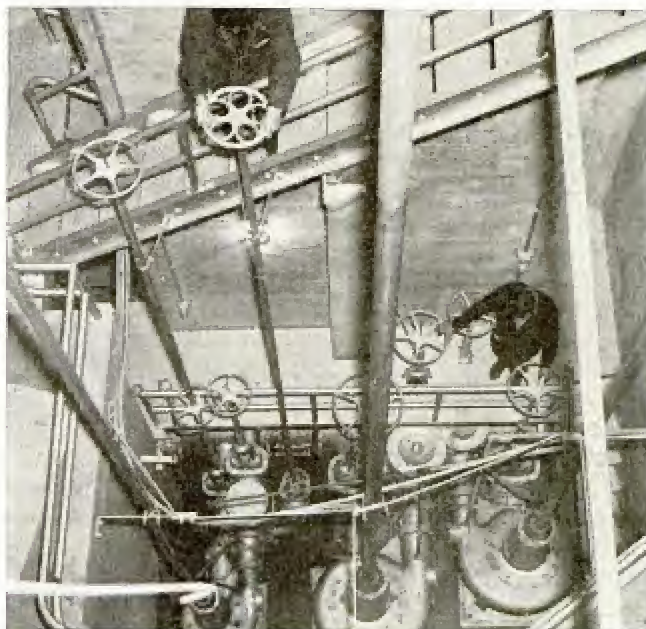
A new type of location finder was built for communication with those above, who followed his movements all the way. With this, they could communicate with him and determine the exact location of any area he pronounced in need of repair. It is interesting to note that this finder has since been used on the torpedo boats of the "mosquito fleet."

Never before has anyone dared to take such a trip as was made by Brown. He was attired like a man from Mars and even then he was in constant peril. Cave-in, toxic gas, explosion, a runaway boat might at any moment have written



Dressed like a man from Mars, an engineer sets forth on a dangerous expedition through 55 miles of Los Angeles sewers

Looking 35 feet down at the booster pumps of a modern plant





Operating a power sweep that feeds cable down the curved pipe to move a cleaning rod

finis over him and the expedition. But he succeeded, and we may be thankful he did, for his discoveries revealed conditions that surely would have caused the collapse of Los Angeles' mighty outfall, as well as many others, probably just at this moment when they are groaning under war production wastes. A tragedy like that would cripple war production and also take a heavy toll from disease.

Hydrogen sulphide, released by all sewage, was being oxidized by water action to sulphuric acid, which in turn was decomposing concrete pipe and concrete tile joiners. Obviously, this gas must be eliminated. In itself, it is a problem for it is the gas which gives rotten eggs their fragrance and cannot be disposed of openly.

Acting on Brown's recommendations, Los Angeles and many other cities have since made a practice of installing only vitrified clay pipe, which is highly resistant to the action of chemicals. To aid in saving old installations, giant ventilating



An electric fan is placed over a manhole to blow fresh air below to workmen combatting the fumes of sewer gas

plants have been installed to draw off the gas and blow it high in the air where it can dissipate harmlessly.

Another constant war is against explosive gas. This is not often generated from sewage itself, although some explosive substances from industrial plants—benzine, gasoline, or ether—may create hazards. The explosions are caused by leaks in underground gas mains which let combustible chemicals seep into

the conduits. A sewer explosion is more devastating than most bombs. Not only does it wreck property, take human life, and lay a community open to plague, but it can tie up industry for thousands, even millions of man hours—time we cannot now afford to lose.

The old method of testing for explosive gas was to send men to collect samples from manholes for analysis, but it was exceedingly slow. The modern method is to have a light truck outfitted with scientific testing instruments. It is driven up to a manhole, the inspector inserts a rod without getting out and reads on a combustible

Washing down the inside of a storm drain, a sanitary precaution taken during dry periods

gas indicator the amount of explosive present. One truck serves 60,000 holes a year.

There is no known way to keep sewers from becoming clogged. Roots are one of the worst offenders. Soaps, grease, boiler scales, soda, and other industrial wastes have been known to clog drains until one could barely push a pencil through. Sand and ordinary dirt contribute their share. Constant cleaning is the only solution.

Some of this work is done by hand with a harpoonlike device called a sewer rod. It contains two sets of barbed cutting knives which are shoved through clogged pipes by wooden rods which lock together in three-foot segments up to any length.

A machine called a power sweep works with the "harpoon." Carrying several hundred feet of specially tempered wire wound on a reel, it feeds the harpoon through the pipes, revolving it back and forth to grind out obstructions. This will clean about 100 feet per minute.

Another cleaning device is nothing more than the familiar beach ball. Inserted in a clogged drain, it forms itself into the shape of the conduit and is forced forward by water pressure.

This two-man crew is testing at a manhole for explosive gas. They don't have to step from the truck



Inserting a beach ball into a partially clogged drain. Water pressure will push it to remove obstruction



Maintenance crews do not wait idly for drains to become clogged. There are automatic flushing stations in every modern system where water is turned on at frequent intervals to give wastes a boost to their destination. In some larger mains, especially storm

(Continued to page 164)

*Paul Presta 210 Bender Inc
759 N. Milwaukee St
Milwaukee, Wis.*

Iron Pipe Bent Without Heat By Hydraulic Tool



Portable pipe bender eliminates elbows and fittings

Iron and steel pipes can be bent to a 180-degree arc, without heating or filling, with a portable device controlled by hydraulic power. The bender, which requires little physical effort to operate, leaves no kinks or wrinkles in the pipe and saves critical materials by eliminating elbows and fittings. The operation takes less than three minutes. The bender also handles solid bars of steel from $\frac{3}{8}$ to 2 inches thick.

Clay Blocks Protect Buildings From Bullets and Bombs

Capable of stopping machine-gun bullets in their tracks, oblong blocks made of clay, sand and oil are offered as substitutes for sandbags in protecting buildings and other structures from bombs and bullets. The blocks weigh about 50 pounds each, being 18 inches long, nine inches wide and $4\frac{1}{2}$ inches thick. The material is waterproof and provides insulation against heat and cold. Of a muddy color, they merge into the color scheme of a field and become indistinguishable at a distance. Because of their shape they can be built up in domino

fashion to form protective walls, and may be taken down later for use elsewhere. No cement or mortar is needed, although a special liquid binder is recommended for walls of 10 feet or higher in order to prevent sideslip. Gun ports or slits may be left in the walls wherever desired. In tests conducted by the manufacturer, a .50 caliber machine-gun bullet penetrated only about five inches into the block, while a bullet from an infantryman's rifle would mushroom into a ball just beneath the surface of the block.

Single-Treatment Iodine Capsule Is Sealed Until Used

Capsules containing enough iodine or mercurochrome for one application are part of servicemen's first-aid equipment. The ingredients are sealed in a glass bulb, which in turn is protected by a transparent Lumarith plastic tube, made from soda straws, sealed at one end by tightly compressed absorbent cotton. To treat a wound, the cotton becomes saturated with



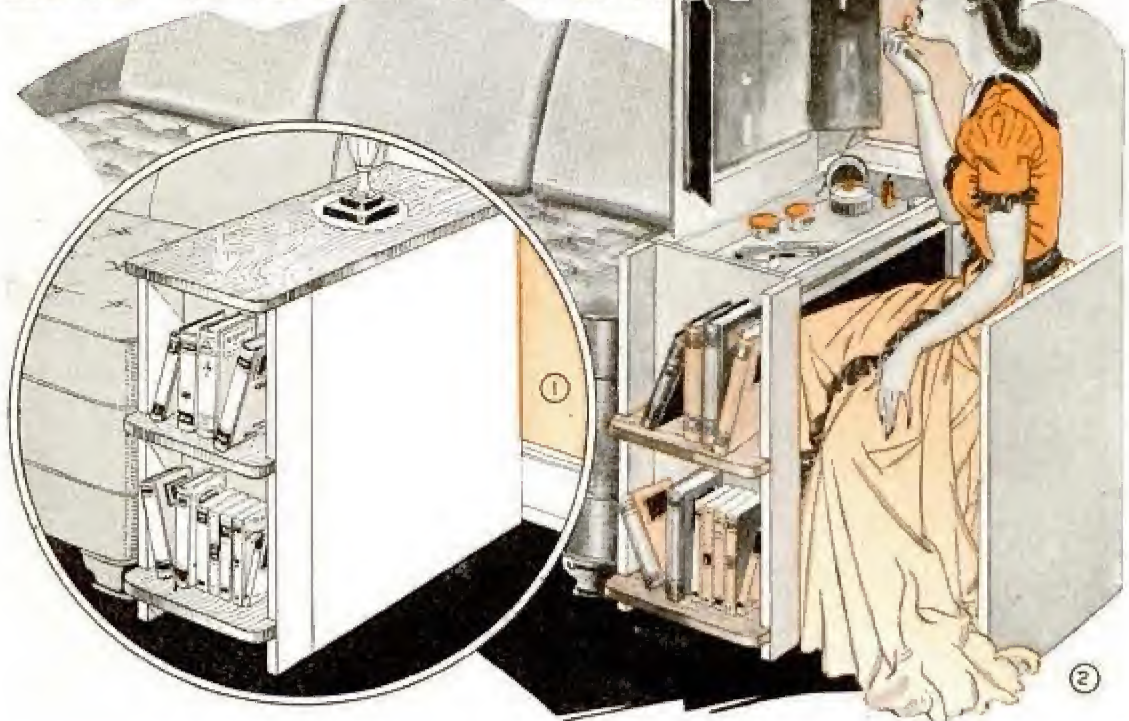
Iodine capsule is used only once and then discarded

the drug when the glass bulb is broken by slightly squeezing the flexible tube between the thumb and forefinger. Each capsule is packed, cotton-end first, in a fiber sleeve, and the contents are kept fresh and potent as they are not exposed to the deteriorating effects of air until the glass is broken. The capsules eliminate the danger from contamination, spilling and broken glass which is present when bottles and applicators are used.



The

CRAFTSMAN

Combination
END TABLE and VANITY

ESPECIALLY suitable for use in one- and two-room apartments where the living room doubles as a bedroom, this compact unit makes the most of limited space by serving both as an end table and a vanity as shown in Figs. 1 and 2 respectively. In pairs they go well at the ends of a studio couch. In this case, only one would be made a vanity, the front of the table being one solid panel and the top fastened instead of hinged. Cutaway views in Fig. 6 show the general construction. A paint-and-varnish job can be had by combining walnut with fir, which will minimize cost and

Double-duty end table opens into midget vanity complete with chair which nests flush to conceal drawers in front

By W. Keith Vining

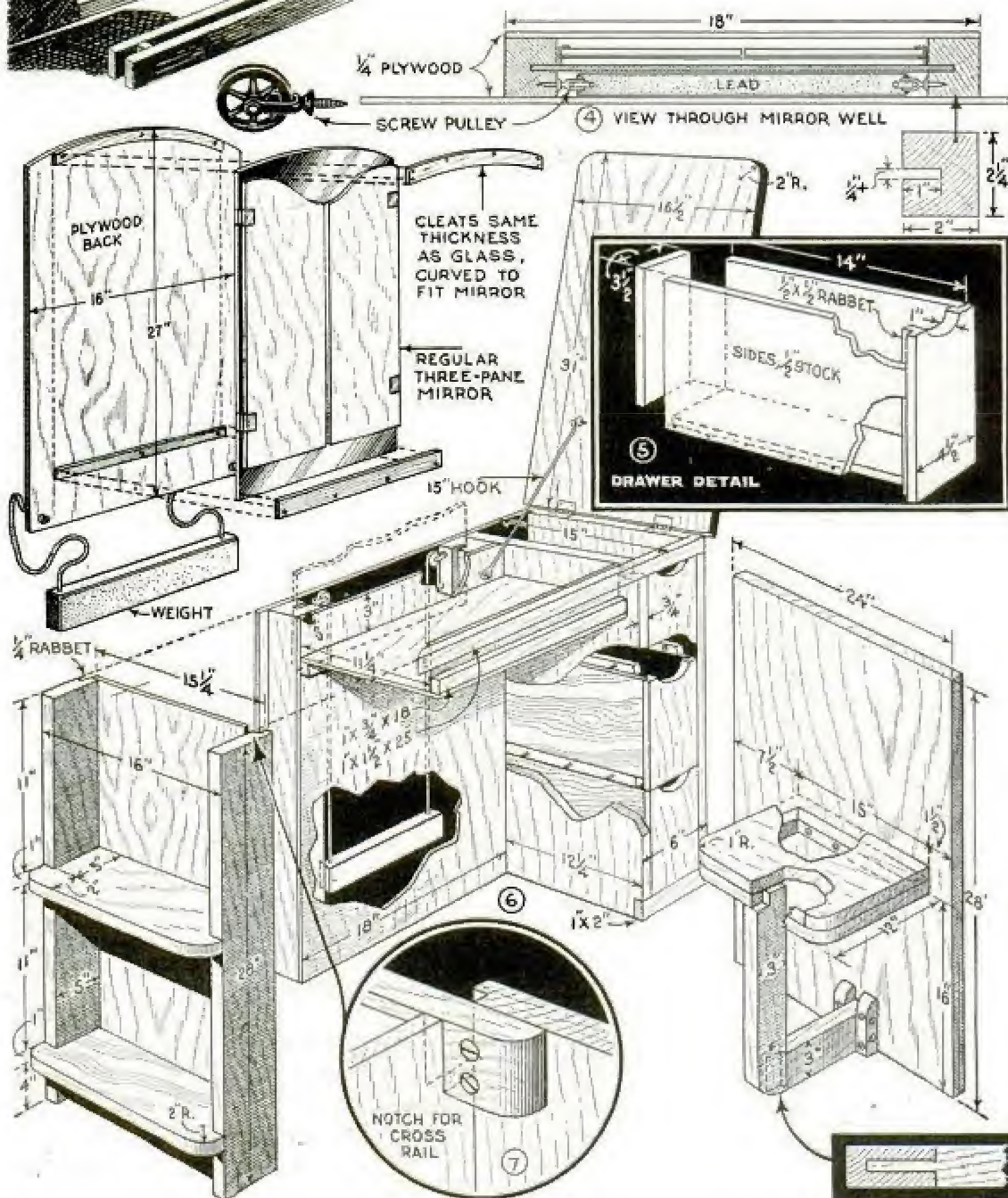
at the same time give a pleasing two-tone effect. Make the unit housing the book niches first. Note in Fig. 7 that a notch is made in the plywood back of this to take the end of the front crossrail. Notice too in Fig. 6 that the rear rabbet is cut wider than the front one to receive the overhanging back of the mirror well. End posts of the latter are grooved 1 in. deep for the panel to which the mirror is attached. Locate the grooves to allow room for a counterweight as in Fig. 4 and cut them a little oversize to assure free sliding of the panel. The front panel of the well can be glued

at the same time give a pleasing two-tone effect.

Make the unit housing the book niches first. Note in Fig. 7 that a notch is made in the plywood back of this to take the



and screwed in place, but the back one should be screw-fastened only to enable you to get at the mirror and counterweight easily. The triple-pane mirror, which can be purchased at a department store, is held to the backing panel by cleats fitted to overhang the top and bottom edges of the glass. The counterweight must equal the combined weight of the mirror and the panel to which it is attached. The weight can be cast of lead, if available, in a simple wooden form as in Fig. 3, or of concrete. Resorting to the latter will require the use of a deeper form to obtain a casting equal in weight to one of lead. Either drill or cast holes in the counterweight for the cords and knot the



ends to prevent pulling out. Then run them up over the screw pulleys and attach to the lower corners of the mirror panel as shown. Now join the book-niche unit to the mirror well and add the drawer and cosmetic compartments. The crossrail ties the assembly together at the front.

The top can be of a single plywood panel or built up of $\frac{3}{4}$ -in. solid stock, glued and doweled. A wire hook supports the top in a raised position. Divide the opening for the drawers into three equal divisions and then cut the drawers accordingly to fit flush. Note in Figs. 5 and 6 that the fronts of the upper two extend to the bottom of the guides, allowing clearance at the hand holes to prevent rubbing. Like the top, the chair back can be of plywood or built up. A padded cushion fitted to the seat will give added comfort. When nested, the back of the chair should come flush with the book-niches.

Tight Gun Action Eased Quickly With Polishing Rouge

If the action of your shotgun or rifle seems a little tight or rough, it is possible that gritty dust or other coarse abrasive has roughened the sliding surfaces. Or, it



might be that the action is normally just a trifle tighter than you like. To get that smooth hand-honed "feel," clean the action thoroughly, then mix polishing rouge with oil to make a brushing paste and apply the mixture to those sliding parts which are objectionably tight or rough. Work the action slowly until the roughness or binding disappears. When the action is just right, dismount the parts, wash them thoroughly in gasoline and lubricate with a good quality gun oil.

JANUARY, 1943

Fuller-Ball Tip on Oilcan Spout For Applying Lotion to Dog



To avoid scratching or bruising the skin of your dog when applying flea lotion with an oilcan, as is frequently done, slip a small fuller ball over the tip of the spout. This permits the hair to be parted for rapid application of the liquid without danger of injuring the dog.

100 W.P.

Child's Toys Stored in Drawer Under Chest or Dresser

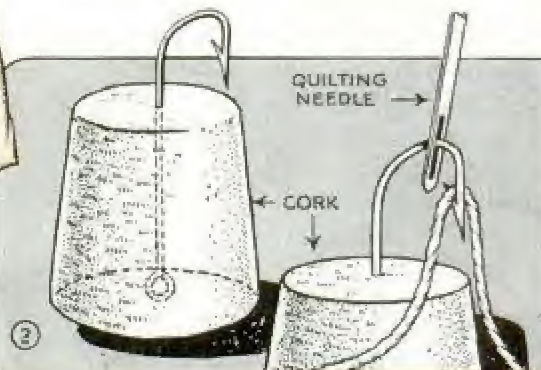
Living in a small apartment where space was restricted, one father added an extra drawer to a dresser in which his small child could store its toys. Slides were provided between the dresser legs as shown, and the drawer was finished to match the dresser, thus providing the extra drawer space without detracting materially from the appearance of the furniture.



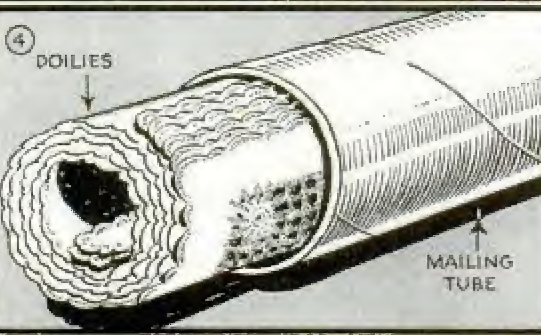
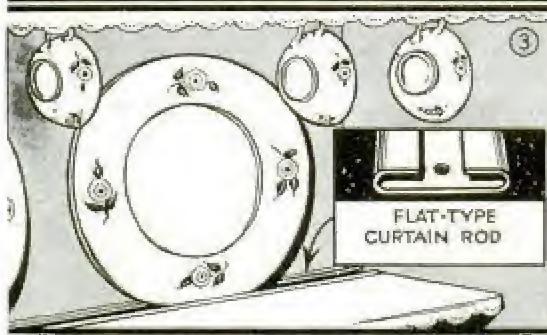
Solving HOME



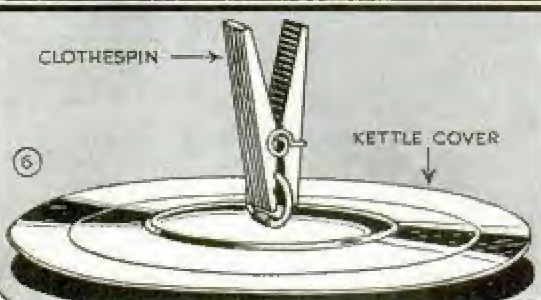
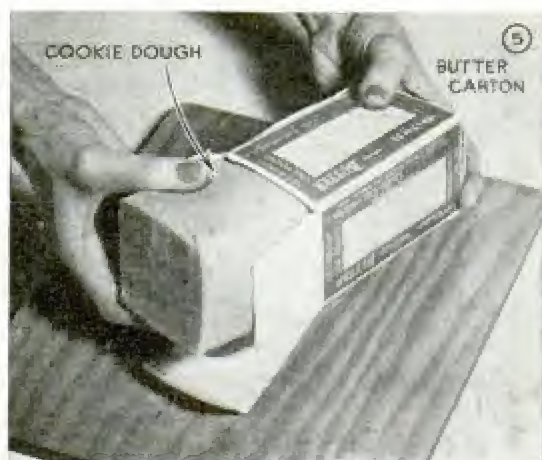
1: You can fasten a cushion onto a chair back for easy removal if button holes are provided at the upper corners to fit over a couple of picture knab-nails driven into the top of the chair. 2: The tedious job of threading a quilting needle is simplified when a cork and fishhook are used. First, the needle is slipped over the hook, then the yarn is placed over the hook barb, after which the needle is removed, pulling the yarn through the eye in a jiffy



3: To keep plates on edge at the back of a cupboard shelf set them in a flat curtain rod screwed to the shelf with the open side up. A strip of wood will serve the same purpose



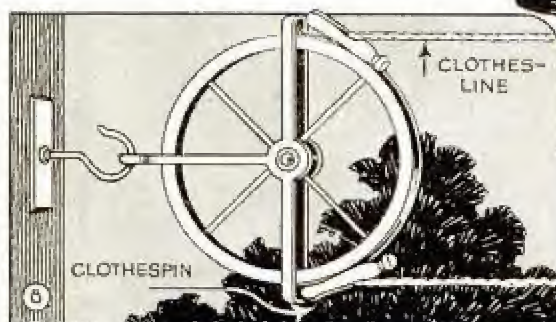
4: Lace or paper doilies can be kept clean and unwrinkled if they are rolled and inserted into a cardboard mailing tube. Paper or cloth can be tied over the ends of the tube to keep out dust



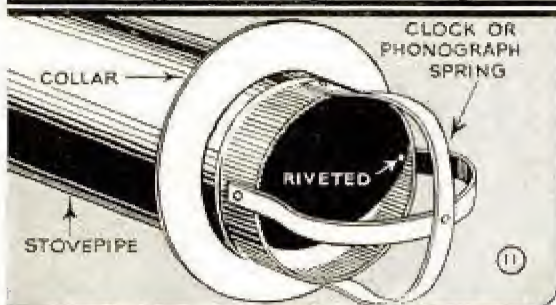
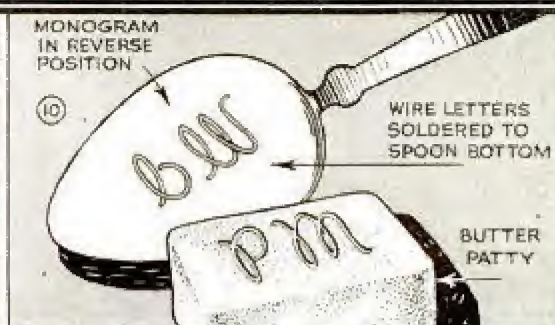
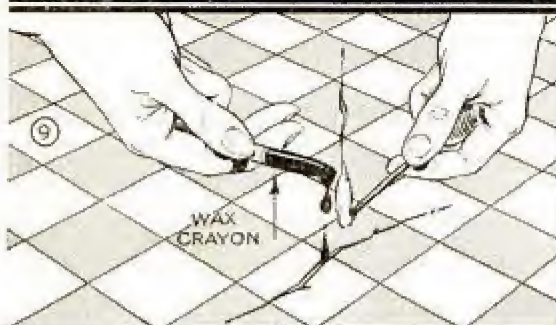
5: Empty butter cartons of the type shown are handy for molding cookie dough that is to be stored in a refrigerator and chilled. As the carton is already waxed it needs no greasing, and takes little space in the refrigerator. When the dough is sliced to make cookies, each one will be of uniform size and shape. 6: Clipped to the finger ring of a kettle cover, a spring-type clothespin provides an excellent handle to avoid burning your fingers, and one that can be removed or replaced instantly as needed. If painted or enameled, the pin will be easy to keep clean

PROBLEMS

7: A grease spot on wallpaper can be removed with a paste made by mixing fuller's earth with cleaner's naphtha. The paste is applied to the spot and allowed to dry thoroughly, after which it is dusted off. 8: When a clothesline pulley of the type shown is noisy on a windy day, because the line has a tendency to move the pulley back and forth, just slip a couple of clothespins over the line and wedge them under the pulley rim as indicated

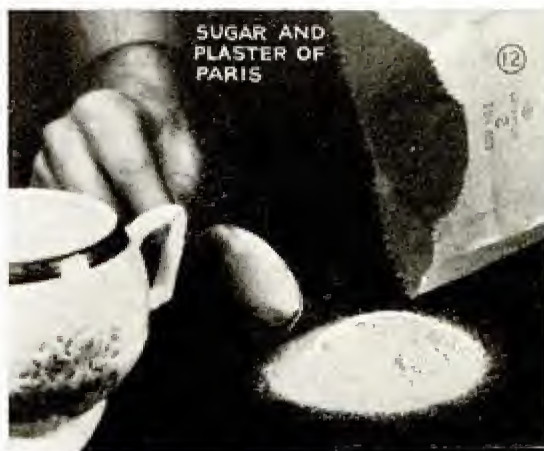


9: Very small cracks and chipped places in linoleum often can be repaired by melting a wax crayon into them, using one of a color to match that of the linoleum around the crack or dent



10: Butter patties can be monogrammed easily for special lunches and dinners with this stamp, which is made by forming the letters from brass wire and soldering them in reverse on the back of a spoon

11: When a stovepipe has a tendency to work out of the chimney opening, just rivet two lengths of clock spring over the end of the pipe so that they bulge out slightly, and then push the pipe into place. Also, the springs prevent the pipe from accidentally being pushed into the chimney far enough to restrict the draft. 12: One home owner eradicates ants in the house by keeping a mixture consisting of equal parts of sugar and plaster of paris spread around the places frequented by the ants



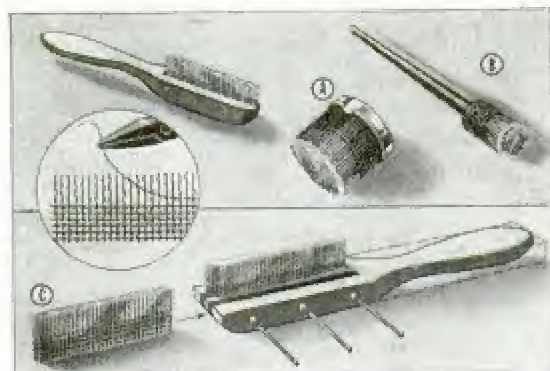
Hunter "Blazes" Trail in Woods With Whiting-Filled Bag



To enable other members of his party to follow him through densely wooded sections, one hunter carried a tobacco sack filled with whiting with which to blaze the trail on the trees instead of employing an ax. A tap of the bag against a tree leaves a visible white mark.

Brushes Made From Screen Wire Have Many Uses

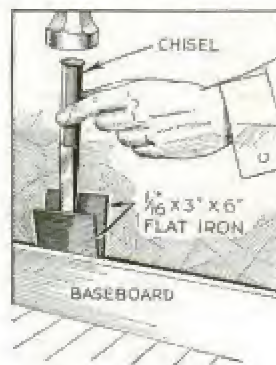
Useful brushes of various sizes and shapes for many purposes can be made from left-over ends of screen wire. For example, the paint scaling brush shown at A is made by fraying the wire, removing about five strands, and then winding the wire to the shape shown. The roll thus formed is bound and fitted tightly into a jar cover. The brush shown at B is made in a similar manner except that the wire is rolled around one end of a dowel and the jar cover is not used. The handy brush shown at C is made by folding the wire to



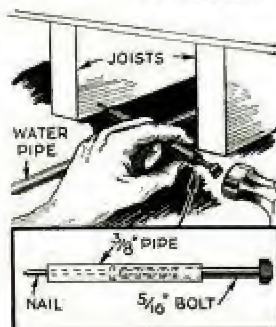
form a strip about 2 in. long and $\frac{1}{8}$ in. thick which is fitted into a couple of slots cut in a handle shaped to suit. The wire is held in place by three small nails.

Baseboard Is Removed Easily By Using Iron Wedges

The next time you have to remove a baseboard, get two 6-in. strips of thin metal and drive these down back of the board. Then place the end of a chisel between the strips and drive it down to pry the board away from the wall. Repeat this operation all along the wall and you can loosen the board without damaging the plaster or wood.



Driver to Set Nails in Places Difficult to Reach



If a $\frac{3}{16}$ -in. bolt is slipped inside a piece of $\frac{3}{8}$ -in. pipe or tubing, you will have a handy tool for driving nails in hard-to-reach places where a hammer cannot be used conveniently. To use the tool, pull back the bolt so that the head end of a nail can be inserted into the pipe for a distance equal to about two-thirds of its length. Then hold the nail in place with the tool and drive the nail as indicated.

—Robert C. Corl, Ft. Wayne, Ind.

WRITE FOR POPULAR MECHANICS!

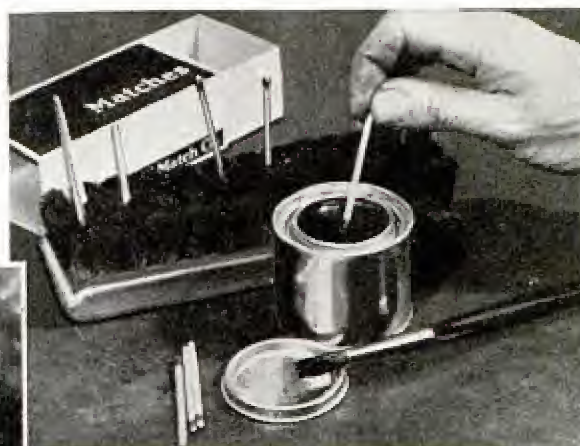
Readers are paid cash for ideas printed on these pages. You too may know of a simpler, faster or better way to do some daily chore about the home, farm, office, shop or garage; an aid to amateur photographers, model makers, workshop fans, car owners, hobbyists, etc. Or, perhaps it's something of unusual juvenile appeal. Just send a short but complete description plus a sketch or photo to the Homecraft Editor of Popular Mechanics. Checks sent promptly for accepted ideas.



What you can do with -LACQUER-



Transparent or colored lacquers and even nail polish will serve many purposes in the home and shop. The outer covering of a lampcord will not fray near the ends if you coat the edge with lacquer as shown above, which is done before the cord is connected inside a plug or socket. Above, right: By brushing some lacquer on the threads of a machine screw before driving it, it will stick tightly and vibration will not loosen it



Above: To waterproof matches, dip them in lacquer and stick them end up in a brush to dry. Left: By adding lampblack to lacquer, thinned to consistency of water, you can prepare a paint to use on photographic and optical equipment



Nails can be made more rust resistant and they will hold better if they are dipped in thinned lacquer in which some sealing wax or rosin has been dissolved



Reference charts, tables, plans and other printed matter, which is likely to be soiled by constant handling, can be protected with a coat of transparent lacquer

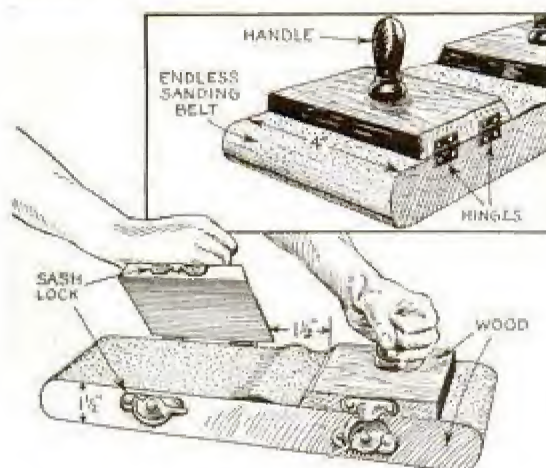
Wood Strips Elevate Sheet Metal For Easy Cutting



To handle and cut large sheets of metal easily, a tinsmith has one end of his bench fitted with V-strips of wood, spaced about 6 in. apart. This allows the sheets to be picked up and moved easily and also permits the insertion and operation of the shears to better advantage.

Heavy-Duty Hand Sander Uses Endless Sanding Belts

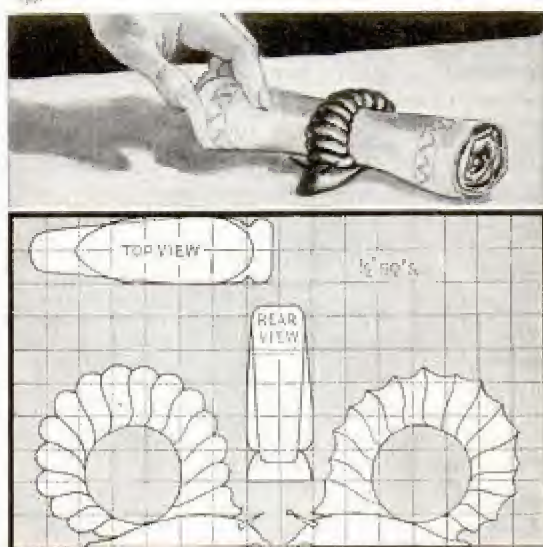
With this sander you can go over a large surface in a short time, and it is just a matter of loosening a couple of window-sash locks and shifting the abrasive paper to bring a new sanding surface into use. The sander is made from 1½-in. stock and can



be any size desired to suit sanding belts you have available. Two thin wood blocks fitted with hand grips and hinged to one side of the block hold the sanding belt when they are pulled down with the sash locks. A piece of felt glued to the underside of the block between it and the paper will provide a good resilient backing for the paper.—H. F. Unger, Cleveland, Ohio.

Napkin Holders Resemble Snails

Anyone wanting to "try his hand" at simple carving will find these novel napkin holders just the thing, and when finished, they make a pleasing table decoration. First make a pattern by drawing the snail on paper marked off in ½-in. squares as indicated. Then transfer the pattern to a block of 1-in. hardwood, and roughly jigsaw the block to shape. Shaping of the



work can be done with a sharp knife or a set of carving tools. Finishing can be done with brightly colored paint, or if you want a more conservative finish, stain and varnish can be used.

—C. B. Wing, Jr., St. Ignace, Mich.

Crayons Decorate Flowerpots

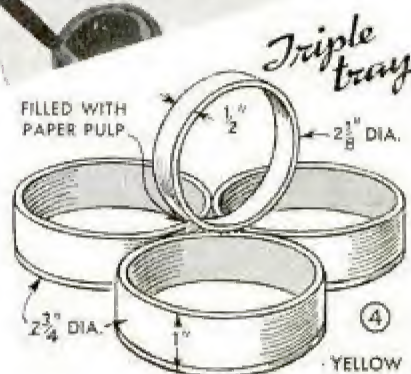
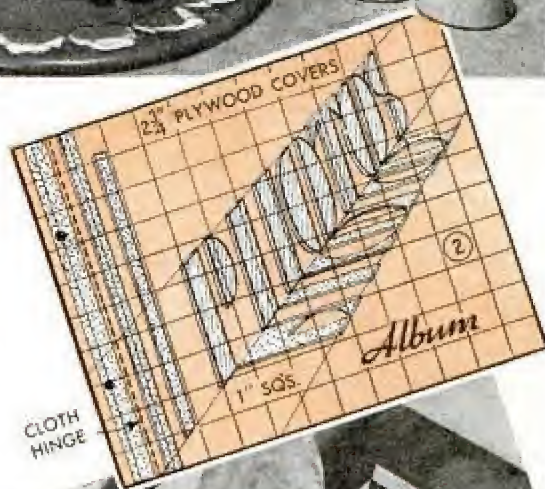
You can decorate flowerpots nicely with ordinary wax crayons. Bands or designs are marked on the pot lightly with chalk or soft pencil, after which the crayons are used to fill in the colors between the lines. The texture of a clay pot will give the design a soft, pebbly finish, blending readily with its surroundings.

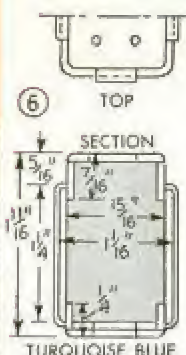
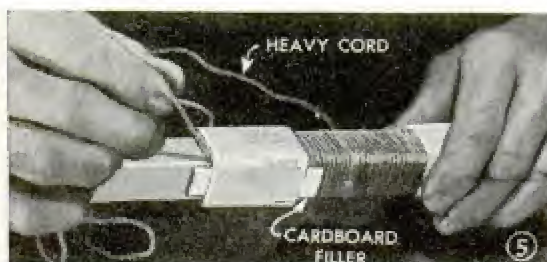
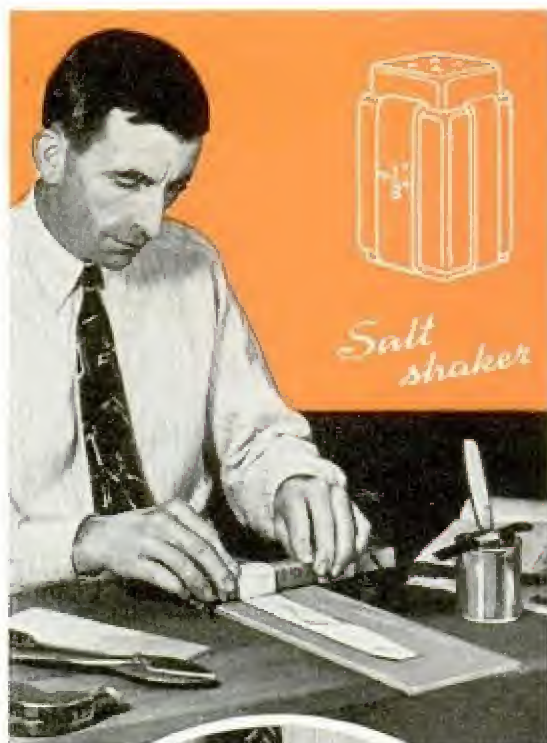


Christmas gifts of **PAPER**

PAPER and cardboard glued up in layers to form sheets or tubes can be used as a substitute for wood and metal in making many useful articles such as those shown in Fig. 1. Material formed in this way can be sanded, cut with a saw and, when sized with glue, it can be painted, enameled, etc.

The photo album in Figs. 2 and 3 shows the sheet material cut into strips and letters and used as overlays. These are coated on one side with glue, which is allowed to become tacky before pressing them into place. This saves time as the paper adheres more quickly so that the work can progress without the usual long waiting period. When attached, the overlays are sanded, sized and finished as desired. Round tubes such as were used in making the triple tray shown in Fig. 4, are built up of both paper and cardboard. For small tubes, paper alone is sufficient. It is coated on one side with glue and then wound on a dowel or other form of suitable size to produce a tube having walls from $\frac{1}{16}$ to $\frac{1}{8}$ in. thick. A strip at the starting end equal in length to the periphery of the form must be left uncoated so that the finished tube will not stick to the form. Cans may be used as forms for making large tubes. First

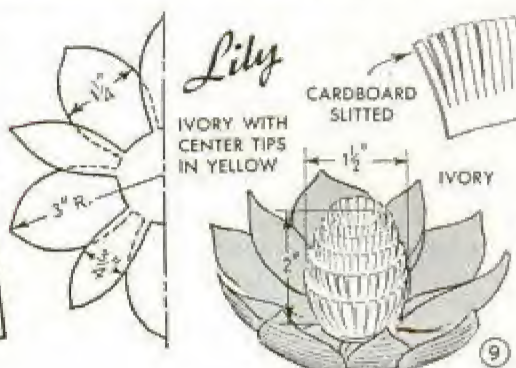
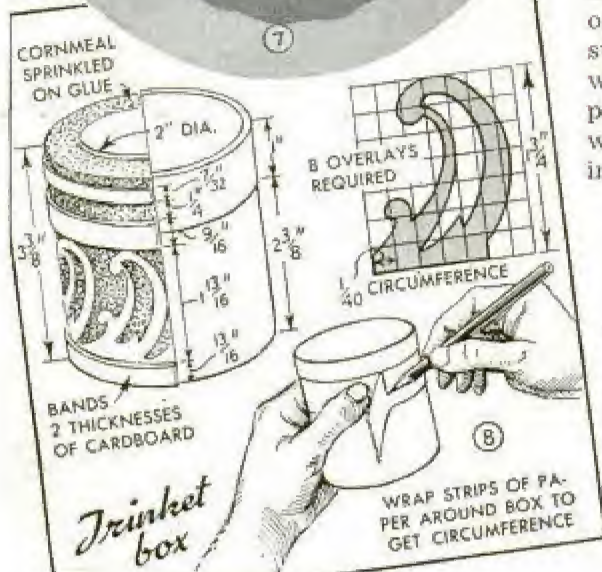
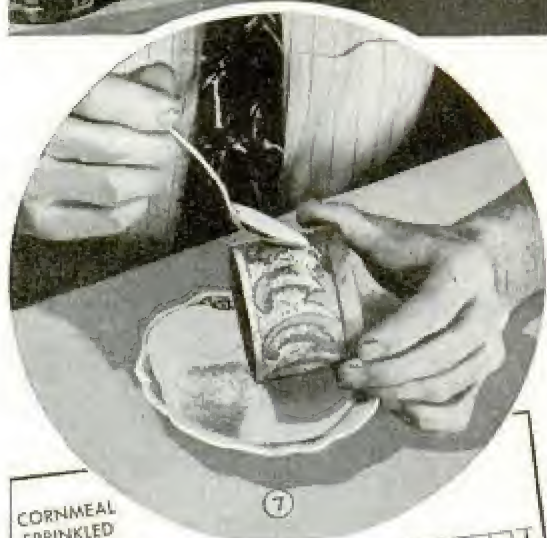


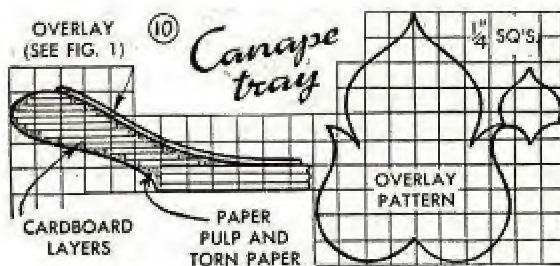


find the circumference of the can by cutting a strip of paper to fit around it. Then, using the paper as a pattern, cut three or four pieces of cardboard, fold them separately around the form and fasten them at the edges with glued paper strips or paper tape, staggering the joints. Wind paper over this, in the same way as in making the small tubes.

To make the tray, sections are sawed from a tube as in Fig. 22, and are fitted with cardboard bottoms glued in place, after which the sections are glued together at their sides and the space between them is filled with paper pulp. The handle is a section cut from a smaller tube and glued in place.

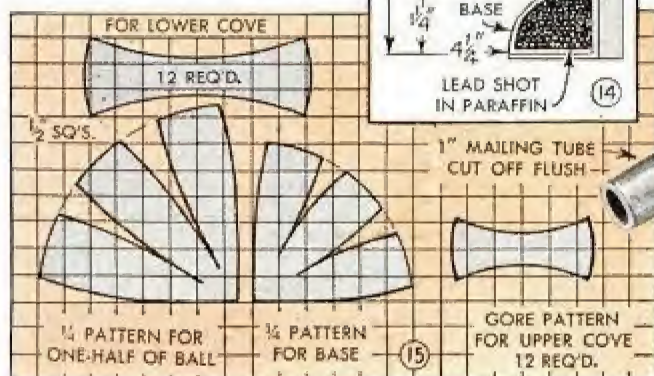
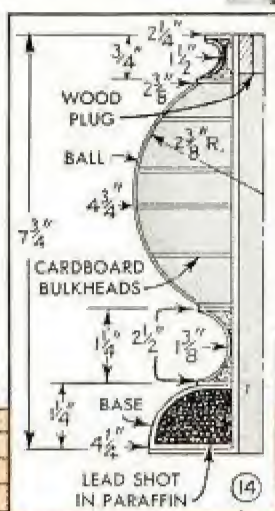
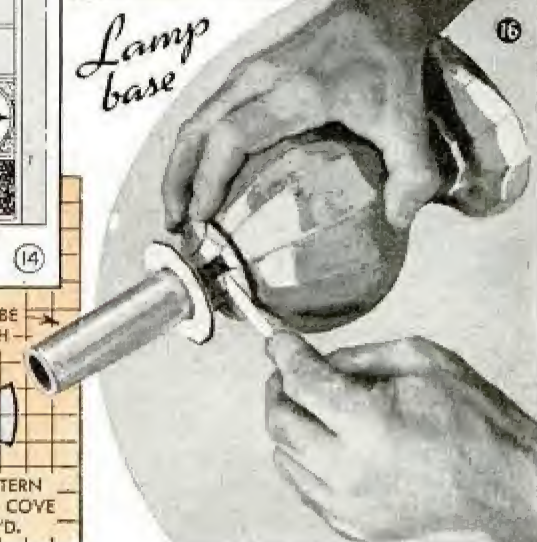
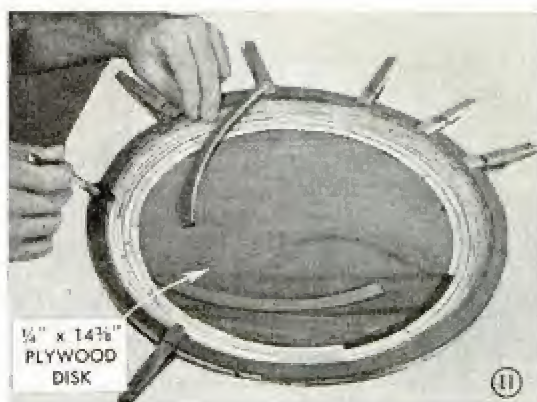
An unusual set of salt and pepper shakers can be made from square tubing as indicated in Fig. 6, using one size for the body and another to glue into each end for the narrower parts. Tops and bottoms are closed with heavy cardboard, the shaker and filler holes being drilled later. After rounding the corners on the outside, the inside corners are cleaned up with a file or a piece of sandpaper wrapped around a stick. Then overlays are glued on, after which the shaker is sanded and sized for painting. In making square tubing, cord is wound tightly over the form before applying the glue-coated paper, Fig. 5. Unwind-





ing the string after building up the tube aids in removing it from the form. As in round tubing, the first turn of paper or cardboard must be left uncoated so the finished tube can be slipped off the form. Possibly the tube will shrink at the ends as it dries. If this is objectionable, use cardboard strips to enlarge the form so that the ends will be slightly oversize. After shrinking, the tube will be uniform in size throughout its length. The corners can be made sharp by adding two or three thicknesses of paper at these points. They are sanded to shape after drying. Large tubing also can be made by using square or rectangular cans as forms. When this is done, it is unnecessary to wind string on them as the tubes will slip off easily. Both cardboard and paper are used also for large square tubing.

The trinket box in Figs. 7 and 8 shows the combined use of round tubing and overlays ornamented with cornmeal to produce a stippled background. After gluing on a disk bottom, apply the overlays as indicated. Then coat the box between them with thin glue, and run a pointed instrument along the edges of each overlay to make narrow scores in the glue. When the overlays are painted





SOCKET
ROLLED
FROM GLUE-
COATED
CARDBOARD

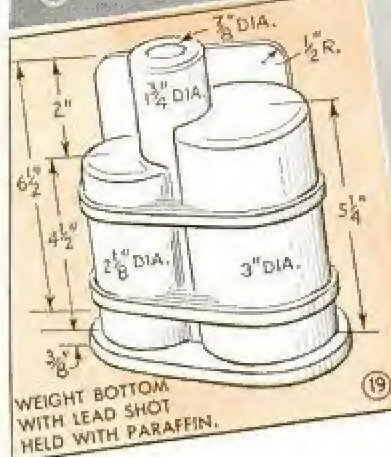


ROUND OFF



ones indicated in the right-hand detail of Fig. 10, and apply them inside the tray as shown. A flower to decorate the tray is shown in Fig. 9. Three thicknesses of cardboard are glued up for each petal section and rolled on a tube to shape them. After assembling the petal, the center of the flower is formed with five slitted strips of cardboard, each being progressively wider. These are glued in the center of the petal assembly, after which the completed flower is glued to the tray.

The lamp shown in Figs. 14, 15 and 16 is an example of building with gored sections of cardboard. The ball of the lamp is made in halves, which are braced with cardboard



later, these scores will keep the paint from running into the background color. Next sprinkle cornmeal on the tacky surface, and while it is drying, make the box lid. This consists of a cardboard disk with a band glued around it to slip over the top of the box.

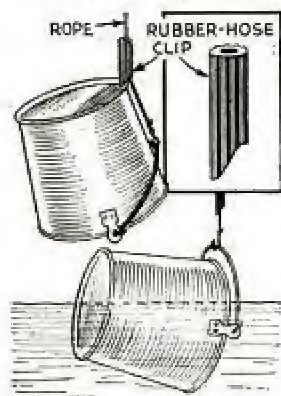
Begin the canape tray in Fig. 1 with a plywood disk as indicated in Fig. 11, and build up a rim on it with layers of cardboard arranged step fashion as shown in the left-hand detail of Fig. 10. Then smooth up the stepped surface with paper pulp pressed into place firmly with a spatula, Fig. 12. When partly set, smooth the pulp with a clean spatula dipped in glue. Complete the rim with torn pieces of paper picked up with the glue brush and pressed to the glue-coated surface as in Fig. 13. The paper coating provided in this way sands down better than the pulp surface. Next, cut out cardboard overlays like the

bulkheads and then assembled around a center tube, Fig. 14, by pulling the edges of the gores together and fastening them with gummed or glue-coated paper. For the coves, or narrowed necks, separate gores are bent in over a solid base of cardboard strips and filler of wet pulp. Cardboard washers are slipped over the tube and the gores are bent in between them. Then, a wooden plug is placed in the upper end of the tube for attaching a lamp socket. Notice that the base is weighted with lead shot in paraffin, the paraffin being used to keep the shot from rattling when the lamp

is moved. Irregularities in the paper work can be corrected by modeling with paper pulp or gesso, which is sanded smooth.

An unusual pair of book ends is shown in Fig. 20. Assemble them by cutting the large cylinders to fit around the candlesticks, mounting them on bases and backs of plywood as shown in Figs. 19 and 21. The bands are three thicknesses of cardboard widened between the cylinders with four or more plies, and the candlesticks are made as indicated in Figs. 17 and 18.

Self-Dipping Pail for Cistern



The difficulty of tipping a bucket to bail water from a cistern was overcome by one farmer who used a simple clip. This consists of a short piece of hose, which is shaped as shown and slipped over the rope above the bail of the bucket. Be-

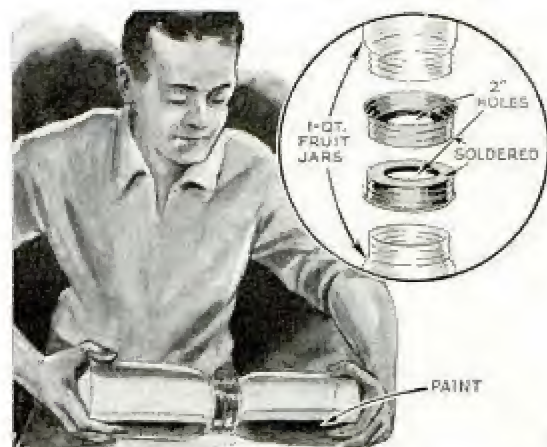
fore lowering the bucket into the cistern, it is inverted and held in this position by slipping the lip of the hose over the rim around the bucket bottom. When lowered to the water, a jerk on the rope releases the clip and permits the bucket to fill.

Pencil Lubricates Pipe Stem For Easy Fitting

If the friction stem of your pipe fits so snugly in the bowl socket that it is difficult to remove, wipe the socket dry with a pipe cleaner or piece of cloth and then insert and rotate a pencil point to coat the socket with graphite. This will lubricate the wood for easy removal of the stem and also tend to prevent absorption of moisture.

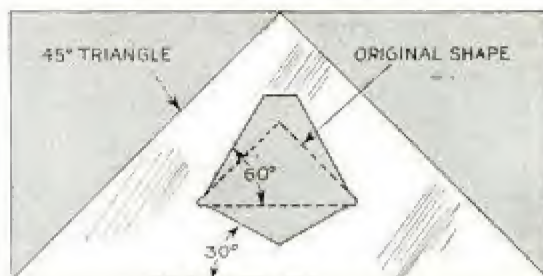


"Boxing" Paint in Two Fruit Jars Assures Thorough Mixing



One home craftsman solved the problem of mixing small quantities of paint thoroughly by joining two fruit jars at the lids and then shaking the paint back and forth in them. The jars are joined by first breaking out the porcelain liners in the lids, then cutting out the tops and soldering the lids together back to back. Use a jar rubber with each lid to make a tight seal.

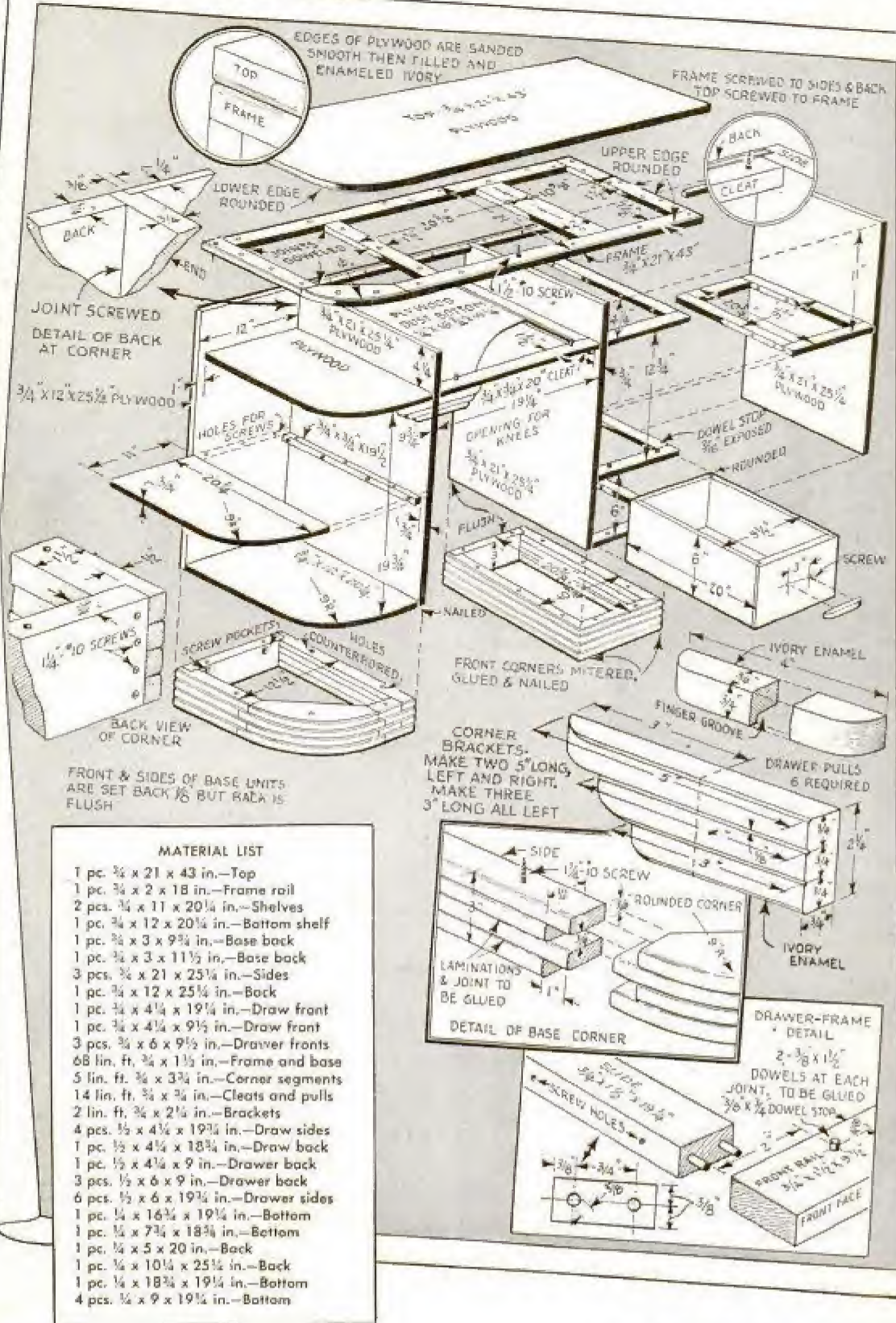
Altered Triangle Saves Time When Drawing Threads



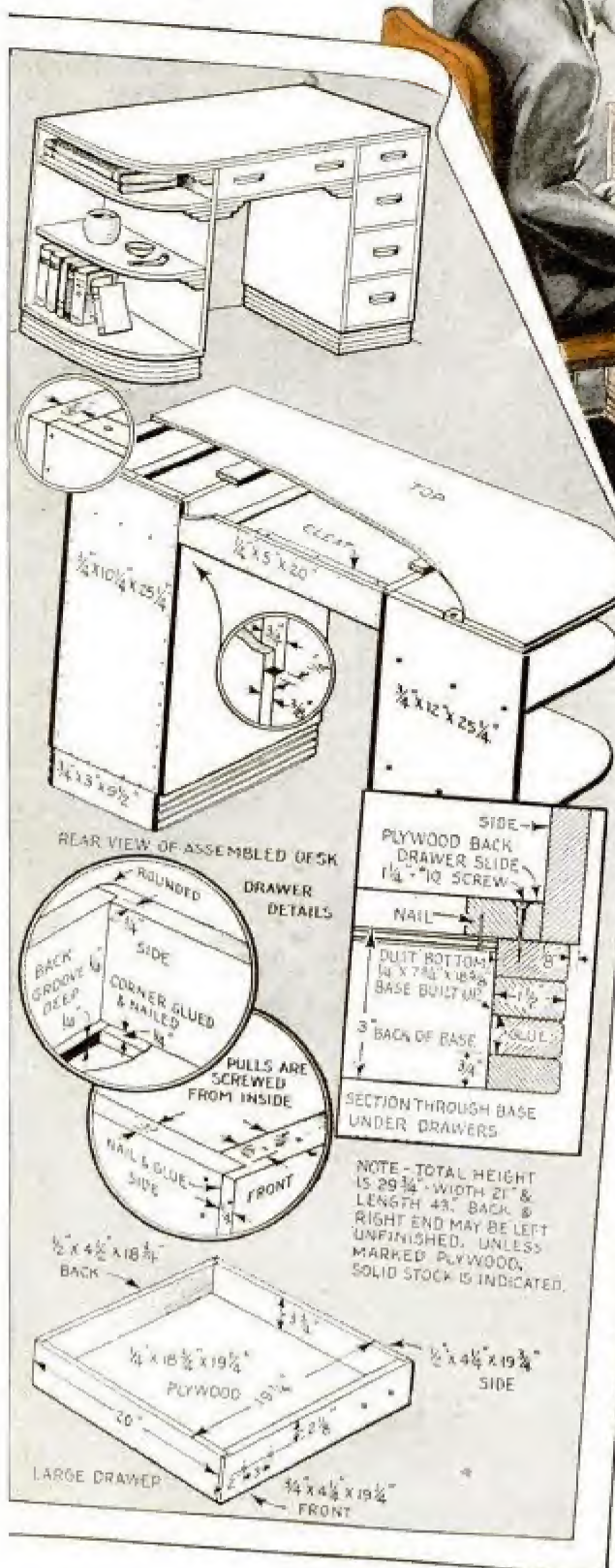
Any draftsman who uses an ordinary triangle and sometimes has to draw threads or do other work that requires alternate 30 and 60-degree angles, will find this method of altering a triangle a timesaver as it makes it unnecessary to turn over the triangle each time a line is drawn. By cutting out the center of a 45-degree triangle as shown, and using it in the position indicated, screw threads can be drawn either vertically or horizontally without raising the triangle. And by turning it you have two opposite 15 and 75-degree angles. The same idea can be used for other angles that are used often.

—A. C. Hills, East Orange, N. J.

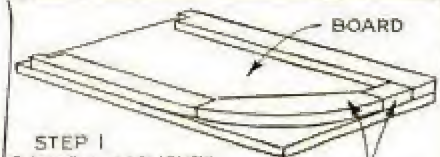
Modern CORNER DESK



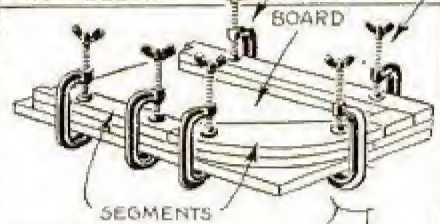
of plywood



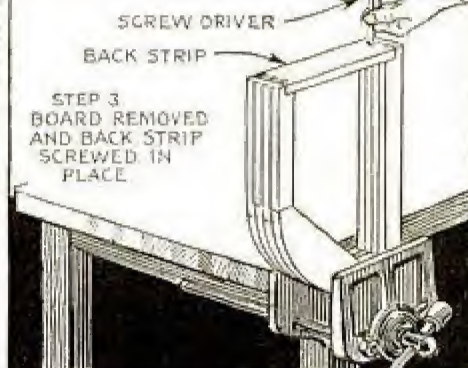
SHELVES MAY BE AT EITHER END



STEP 1
BOTTOM SEGMENTS
ARE SCREWED TEM-
PORARILY TO BOARD
FROM BELOW

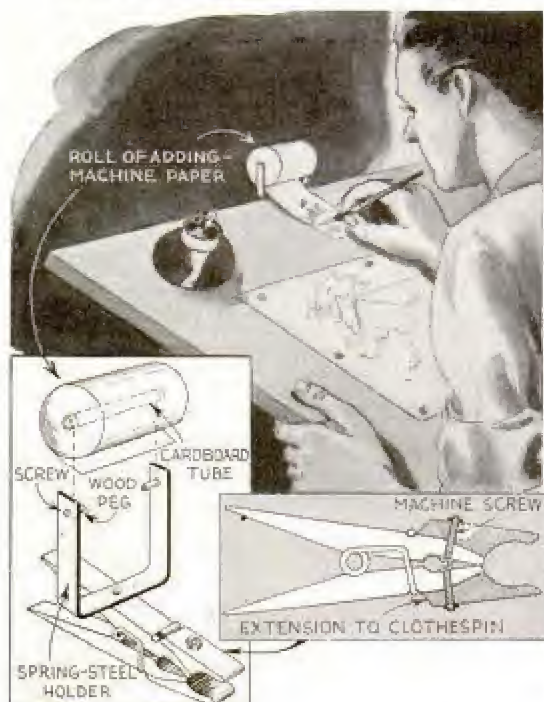


STEP 2
SECOND AND
SUCCEEDING LAYERS
OF SEGMENTS ARE
GLUED IN PLACE



STEP 3
BOARD REMOVED
AND BACK STRIP
SCREWED IN
PLACE

Artist's Pens and Brushes Tested On Adding-Machine Paper



Instead of testing his pens and brushes on the drawing board, one artist uses a roll of adding-machine paper for the purpose. This is kept in a holder made by bending a piece of metal to the shape indicated, after which it is fastened to a spring-type clothespin, the latter being fitted with wooden extensions held in place with machine screws. In use, the holder is clamped over the edge of the drawing board in a convenient position.

Surplus Cord From Lamp Stored In Adhesive-Tape Reel

The unsightliness of surplus lamp cord lying on the floor can be avoided by winding it on an empty adhesive-tape reel. One

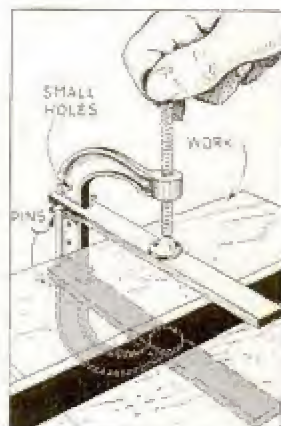


side of the reel is bent outward to permit passage of the cord when the reel cover is replaced. If there is room under the base of the lamp, the reel can be placed under it out of sight. However, if the reel must lie on the floor, it can be painted to match the floor so that it will not be conspicuous.

—Benj. Nielsen, Aurora, Nebr.

Throat of C-Clamp Increased By Two Wooden Bars

Increasing the throat of a C-clamp to handle wide work is a simple matter if you use a couple of wooden bars fastened to the clamp as indicated. Hardwood is best for this purpose, and the bars will be stronger if they are built up of two or three



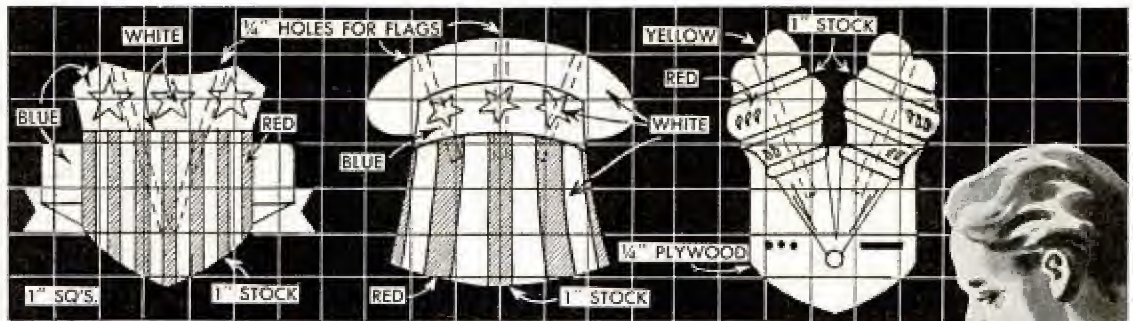
strips glued and screwed together. In use, have the outer ends of the bars a little closer together than the ends next to the clamp so that pressure will be transmitted to these ends. This will help compensate too, for the tendency of the bars to bend slightly when the clamp screw is turned down.—A. H. Waychoff, Phoenix, Ariz.

Funnel Expands Stove Pipe To Lock Seams Quickly

Next time you buy stove pipe that has the seams open, you will find a large funnel helpful in closing them. Just put the funnel upside down on a table or bench and force one end of the pipe down over it. This expands the pipe, pulling the interlocking joint together. Reversing the pipe will close the seam at the other end.

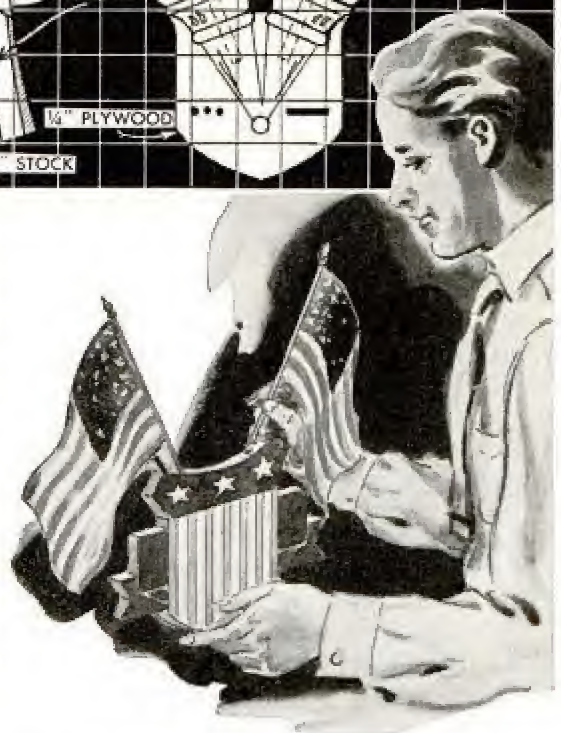


Patriotic Plaques Display Small Flags on Wall



You'll find these colorful plaques are novel and attractive ornaments used for holding small flags displayed on a wall of your home. After enlarging the sketches on paper, which has been marked off in 1-in. squares, the designs are cut out and used as full-size patterns. The plaque simulating Uncle Sam's hat is jigsawed from 1-in. stock, and three $\frac{1}{4}$ -in. holes are drilled to take the staffs of the flags. The shield is made in the same way except that only two flags are used. For the torch plaque, torches cut from 1-in. stock are glued to a $\frac{1}{4}$ -in. plywood shield. The plaques are painted as suggested, and are held on the wall by small mirror hangers.

—R. L. Fairall, La Crescenta, Calif.

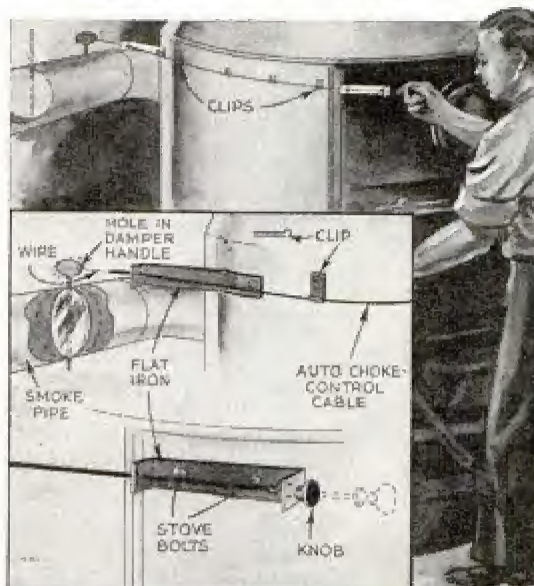


Smoke-Pipe Damper Controlled at Front of Heating Plant

This simple control will save you many steps by making it unnecessary to walk behind the heating plant to open or close the damper, which often is located where

it is hard to reach. The control consists of an auto choke-wire cable fastened to the damper handle, the knob end of the cable being located at the front of the plant within convenient reach. A wide, U-shaped bracket, which is attached with stove bolts, anchors the fitting at the knob end of the cable, small clips being used to support it between the bracket and damper.

—W. J. Oforsagd, Port Arthur, Ont., Can.



Easy Way to Open Preserve Jars

When making preserves, place a milk-bottle cap in the paraffin cover of each jar just before it hardens. The covers can be removed and replaced easily with the little tabs on the caps.



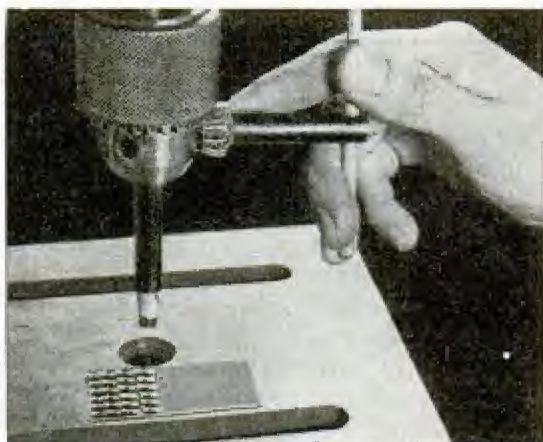
Scale for Duplicate Weighing Improvised From Spoon



When it is necessary to weigh out duplicate portions of chemicals or other materials and there is no scale at hand, you can improvise one that will work satisfactorily where accuracy is not too critical. Suspend a spoon from a string as indicated, and then wrap a small piece of lead around the handle so that it can be moved back and forth to balance the desired amount of chemical. Once the scale is adjusted to the desired amount, the weighing operation can be repeated indefinitely.

Eraser "Frosts" Metal Surfaces

A pencil-shaped eraser of the kind used widely by typists can be used in the shop to spot or frost bright metal surfaces, producing an effect like that decorating the inside of some watch cases, or the scraped surfaces of machines. To do this, insert the eraser into the chuck of a drill press or electric hand drill, and rotate it at medium speed. Touch the eraser against the metal for a second or two; then move it or the work sidewise, and make the next spot.



Various designs can be worked out by varying the spacing and overlapping of the spots. The abrasive in the eraser works best with soft metals, plastics, etc. For harder materials you can cement disks of fine abrasive paper or cloth to the eraser tip, the rubber acting as a cushion.

Hardening of White-Lead Paste Avoided With Water

Painters and others who have had the experience know how difficult it is to keep white-lead paste from hardening after the containing drum has been opened and a portion removed. To avoid this, one painter levels the remaining paste in the drum and then pours about 1 in. of water on top of it. This prevents air reaching the paste.



Pocket in Leg of Ski Trousers Handy for Accessories



Sewed to the leg of your ski trousers below the knee, a large pocket provides a handy place to carry ski wax and other essentials. If these are carried in your coat or hip pockets, they might prove a source of injury in case of a fall. Be sure a flap is provided to be buttoned down over the pocket to prevent loss of the articles carried in it.

—Jos. Keenen, Fort McIntosh, Tex.

Applying Limed-Oak Finish

To secure a limed-oak effect on wood, stir unslaked lime, 1 lb., into water, 2 qts., and rub the mixture across the grain of the wood. When partly dry, wipe off across the grain to remove the excess lime. Seal with two thin coats of white shellac and finish with a thin coating of paraffin wax.

You'll find it a fascinating hobby to produce these beautiful flowers in a miniature, table-top greenhouse, where the necessary humidity and temperature can be maintained. You can start by getting a few plants, which can be propagated by division or by cuttings

ORCHIDS

Grown at Home

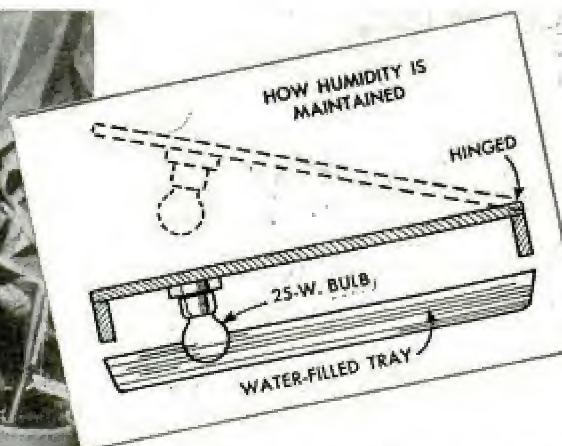
By R. DeWitt Miller

HAVE you wished you could grow your orchids? You can do it inexpensively, right in your own home and without pampering them with constant care. Orchids are not as extremely delicate as many people believe them to be. They're as hardy and easy to grow as almost any other plant. All they re-

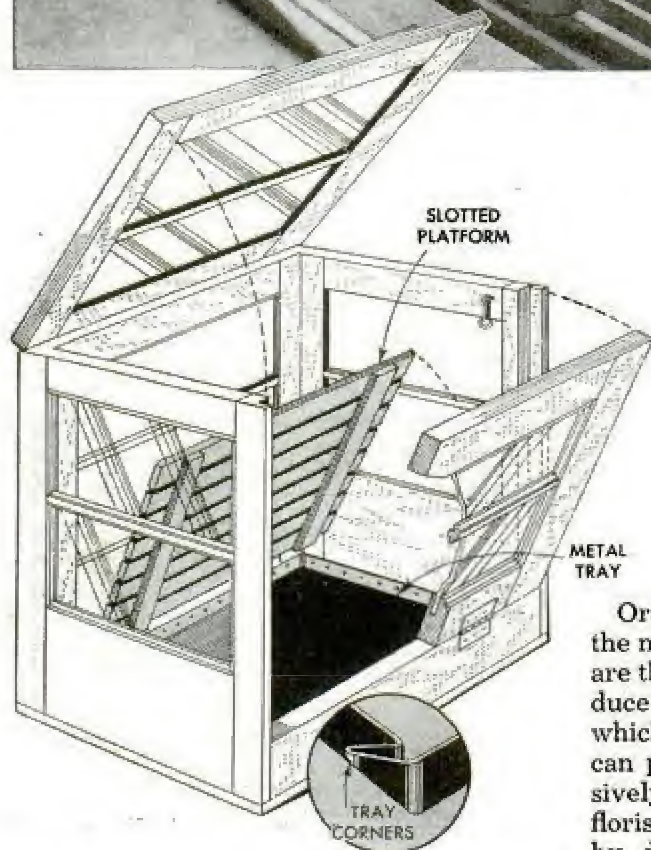


quire is a daily spraying with water and living in a glass house where a temperature of 60 to 75 degrees can be maintained.

The greenhouse can be a simple affair placed on a table. One about 3 ft. square will hold a dozen or more plants. Your best bet is to make it of standard window sash, hinging the top and front sash to permit cooling the interior if the temperature should exceed 75 degrees Fahr. The



Above, switching on a light bulb suspended in a water-filled tray produces the necessary humidity. Left, a ten-cent thermometer can be used to check the temperature, which should be between 60 and 75 degrees



greenhouse is in a heated room, a 25-watt bulb in a socket attached to the underside of the plant platform, below which the tray is set, usually will be sufficient. In cold weather you may find it necessary to use two bulbs. It is well to varnish the case inside and out to prevent warping. The glass side of the case that faces strong sunlight should be given a coat of whitewash to protect the plants from the direct sun rays. Avoid using white paint for this purpose, as it would be difficult to remove if you should want to move the greenhouse to another location where different lighting prevailed.

Orchid plants of the cattleya variety are the most suitable for home culture, as they are the simplest type to grow and they produce some of the loveliest blossoms, one of which is shown on the opening page. You can purchase these plants quite inexpensively from any large horticultural firm or florist. A single plant may be propagated by division. Some home growers even start them from seeds. Orchids require no feeding as they take nourishment from the air rather than from their roots. However, they do require a daily spraying with water, directing the mist at the leaves with a small insect sprayer. They like a continuous supply of fresh air, prefer being dry as a bone in the morning and welcome a bit of humidity at night. While orchids do best in a 60 to 75-degree temperature, they can stand short durations in excess of this. Un-

temperature is maintained by the heat of a light bulb, which also provides the necessary humidity by resting inverted in a metal, water-filled tray. The tray should be 2 or 3 in. deep and should be filled first with a mixture of peat moss and gravel, shredded asbestos or pieces of broken flowerpots and then with water to a depth of 1 in. If the temperature drops below 60 degrees, you merely switch on the light bulb and check with a thermometer. If the

Orchids like fresh air and lots of it. During hot weather the lid of the greenhouse may be propped open as shown at right

der these conditions you can start them at any time of the year. Many find an enclosed back porch an ideal location for the greenhouse, bringing the plants indoors when they start blooming. Although their delicate blossoms wilt in a few days when cut, they remain fresh for weeks on the plant, provided you do not neglect to spray their foliage daily with water. The sight of an orchid blooming in your living room will bring exclamations of amazement from your friends who, like most of us, have looked upon orchid culture as something mysterious and too difficult to undertake at home.

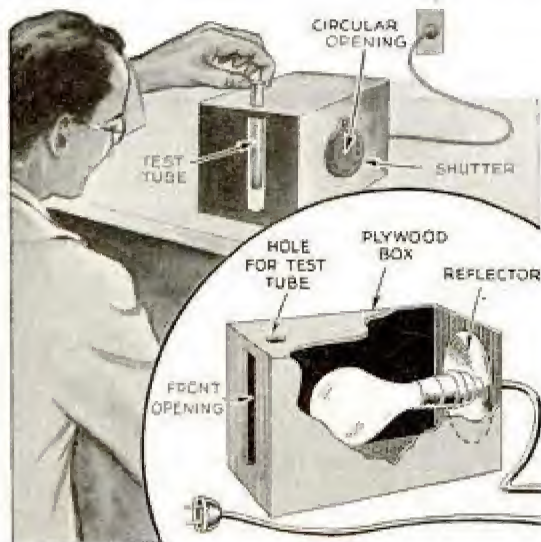


Viewing Box for Test Tube Helps Chemistry Instructor

This simple viewing box concentrates light on a test tube when making a test to enable students to observe closely the results of chemical action. By bringing the specimen close to the aperture in the box, the depth of color, the formation and other qualities are better presented. Specimens of metals can be observed easily by using

the box. Made of plywood, it is fitted with a lamp, socket and reflector at the back, while the front has a slotlike aperture behind which a test tube can be inserted through an opening in the top as indicated.

—H. R. Trelease, Bloomfield, N. J.



Drawing Waxed to Prevent Glue From Adhering to It

If you are in the habit of using full-size drawings on which to assemble small parts with glue, you can avoid having the parts stick to the drawing if you wax it. An easy way to do this is to lay a piece of waxed paper on the drawing and press it with a medium hot iron. The waxed sheet transfers enough of its coating to the drawing to protect it against adhering to the glued parts and still leave the lines visible.



Glass Bookcase Door Over Lamp Makes Ideal Tracing Desk



While tracing a number of drawings which had to be inked, I found that the usual method of holding them up to a window was very tiresome and inconvenient. To make the job easier, I removed one of the glass doors from a bookcase, placed it horizontally between two small tables and then set a lamp on the floor directly under the center of the glass. This arrangement made it possible to do the work in a sitting position and it also eliminated the penciling operation as drawings can be inked directly from the copy.

—W. F. Schaphorst, Newark, N. J.

Eye-Dropper Cap Protects Pocket Against Indelible Pencil

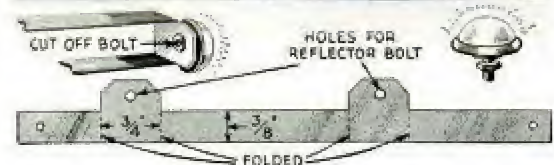
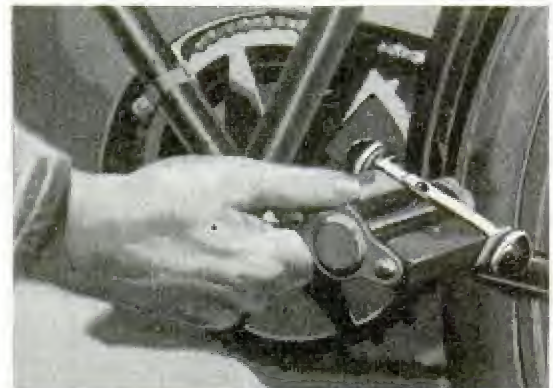
To keep an indelible pencil always at hand and still prevent the point from soiling his shirt pocket, one clerk uses a rubber bulb or cap from an eye dropper. The



closed end of this is pierced and slipped over the lead as shown. The rubber covers the lead directly when the pencil is carried in the pocket and when it is necessary to use it for writing, the bulb is merely slipped back to expose the lead.

Red Reflectors on Bicycle Pedals Attract Motorists' Attention

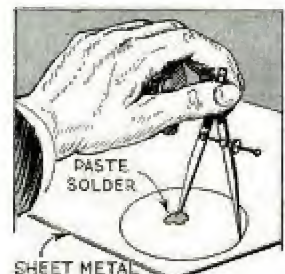
If you ride a bicycle at night, the addition of these reflectors on the pedals will increase your safety considerably. They move with the pedals, thus attracting attention better than the stationary reflector on the seat or rear fender, or even a rear taillight. The reflectors are mounted on a strip of heavy sheet metal cut to the shape



shown. The strip is long enough to be bolted around the pedal, being placed as close to the pedal hanger as possible.

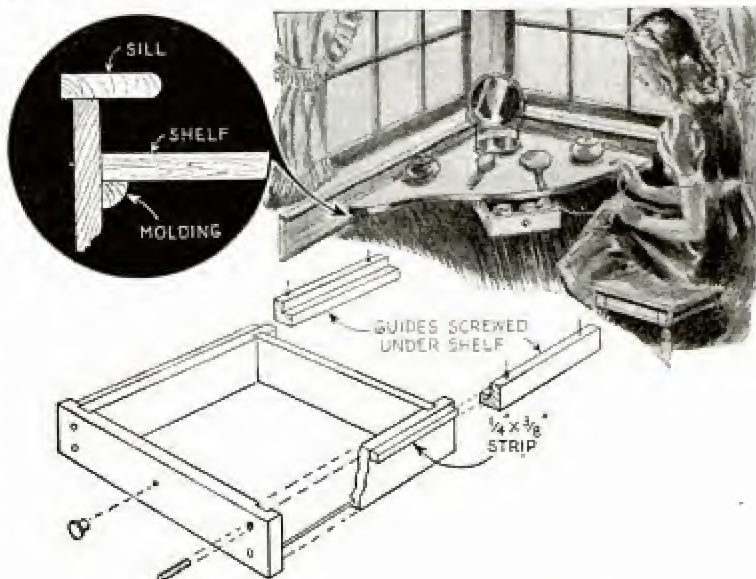
Solder Spot for Dividers Leg Prevents Marring Work

When it is necessary to scribe circles on thin sheet metal and a prick-punch mark for the pivot leg of the dividers is undesirable, a spot of paste solder in which to set the leg will prevent marring. After the circle has been scribed, the solder can be scraped off the metal easily.

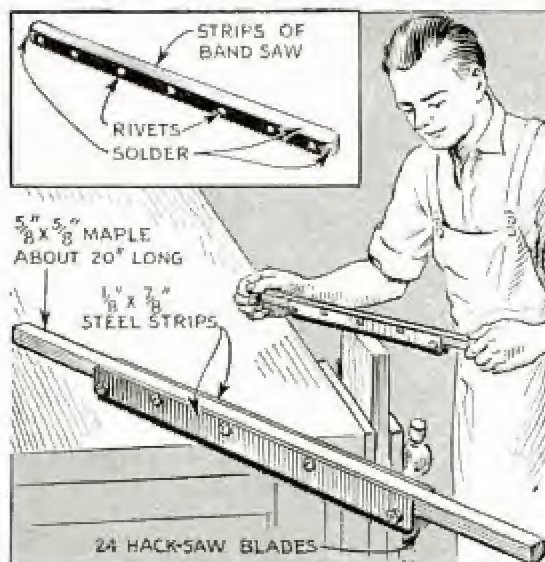


Built-In Dressing Table Under Corner Windows

Installed under a corner window and fitted with a small drawer, a shelf like the one shown provides a convenient and attractive dressing table in space that can be used for few other purposes. Flowered chintz tacked along the edge of the shelf adds a cheerful touch. Construction is quite simple. The circular detail shows how the shelf is supported. Your lumber dealer can cut the drawer pieces to size, and they can be assembled with casein glue.



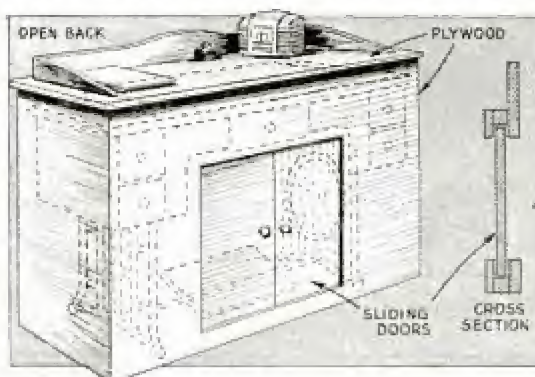
Wood Raspers Made From Blades of Band and Hack Saws



You can make highly efficient wood rasps by assembling pieces of old hack-saw and band-saw blades as shown. The band-saw blades are broken into suitable lengths and then drilled and riveted together, using enough lengths of the blade to make a rasp of the desired width. If solder is available, it can be flowed over the backs of the assembled blades and smoothed down to make a neat back on the rasp. As hack-saw blades are too hard to drill and rivet, they must be clamped in a suitable holder. A length of hardwood with strips of flat iron screwed to its sides will hold the blades. Small bolts pass through the holes in the ends of the blades and through the flat-iron pieces. The wood extends beyond the ends of the blades for hand grips.

Cover For an Old Sewing Machine Also Serves as a Kneehole Desk

If you have an old sewing machine that you like to have handy for use at all times, yet dislike its appearance in the room, this simple cover will hide it and also serve as a kneehole desk. The cover has three sides and slides over the machine. It can be made of any wood desired and finished to suit. Two sliding doors in front can be opened when using the cover as a desk to provide an opening for your knees. When not in use, the doors are kept closed, completely hiding the machine from view.



GOOD TURNS



High-Speed Christie

Double-Stem turn



GOOD control in skiing comes mainly at the turns and therefore various types of turns suitable for different speeds must be mastered fully. The first step in learning to ski is to become accustomed to the skis in walking on level ground and in sliding down very slight inclines. Then you practice the motions of turning at a standstill by means of the kick turn detailed in Fig. 4, which is necessary in order to make a zigzag climb up a slope as shown in Fig. 9. Other methods of climbing are the herringbone method shown in Fig. 8, and side-stepping, which is done on short, steep slopes.

Double-stem or snowplow braking: When coasting down a slight incline at a speed not faster than a walk, you must be able to "apply brakes" by means of a double stem or snowplow, in which position the skis are toed in as shown in Fig. 2. To practice this maneuver you proceed as follows: At the top of a gentle slope of well-packed snow, assume a normal downhill position. That is, place one foot half a shoe length ahead of the other, bend your knees slightly so that your legs will flex in order to absorb shocks of uneven surfaces, and lean the upper part of the body slightly forward so that an imaginary straight line could be drawn through the nose, knees and boot tips as illustrated in Fig. 5. Your hands, holding the poles as in Fig. 6, should be about level with the knees, the poles

mark GOOD SKIERS

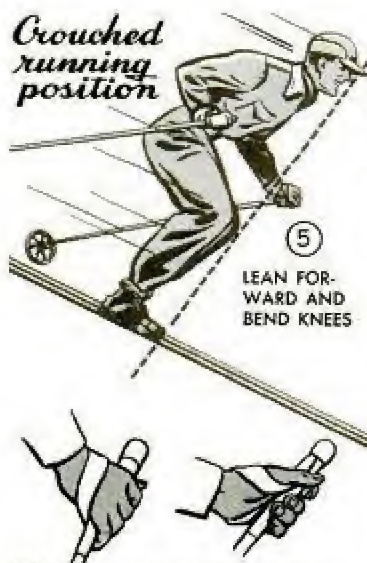


thrust behind. Skis should be parallel and about 3 in. apart. Now, with your eyes on the slope—not on the ski tips—give yourself a push with the poles and you're off. When traveling at the speed of a slow walk, push the heels of the skis out until they form a V. This is the double-stem or snowplow position. The wider the V, the greater will be the braking effect. If the ankles are kept straight the inner edges of the skis will dig into the surface slightly and produce still greater braking force. Keep the knees well forward and avoid a knock-kneed position which is likely to edge the skis too much. In the snowplow position, a moderate braking effect results, one which is easy to control and is essential to the

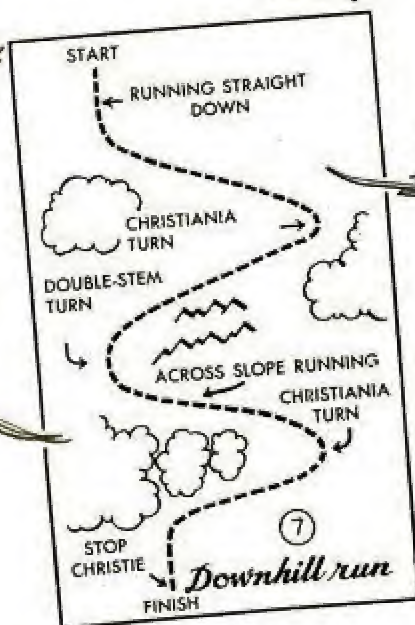




④
*A kick turn
to left*



⑥ PROPER WAY TO GRIP POLES



to execute a snowplow turn to the right, shift your weight to the left or outside ski. At the same time, hold the left shoulder slightly forward, an action that will cause a slight outward turn of the hips. The entire snowplow has to turn around just as if the ski tips were

turned which will come later. When you let the skis come parallel again the braking force will be removed. The snowplow should be practiced until the effect can be applied instantly and eased or released at will.

Double-stem or snowplow turns: After getting the knack of snowplow braking, you start practicing a double-stem or snowplow turn as in Fig. 1. If, for example, while in the snowplow position, you wish

tied together, so don't drag the lighter ski behind. Snowplow turns should be practiced at slow speed on gentle slopes, with each motion smoothly linked with the next, first with a turn to the right and then to the left, alternating until the bottom of the slope is reached.

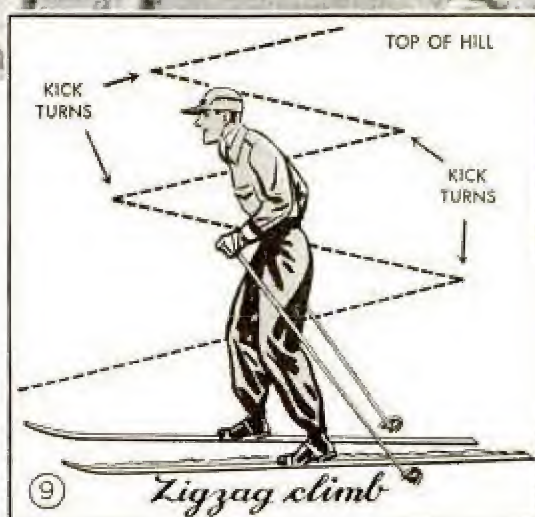
Stem-christiania turn: From the double-stem turn, the stem-christiania turn or stem christie, as shown in Fig. 3, is an easy step. The first half of the stem christie may



⑧ *Herringbone climb*

be considered to be similar to the double-stem or snowplow turn. In the second half of the turn, however, the skis are parallel and skidding appreciably to complete the rest of the swing. The stem christie requires more speed than the snowplow turn. Start the turn from a traverse, (a run diagonally across the slope), by stemming with the lower ski, (abstemmen), and twist the body slightly in a direction opposite to that of the proposed turn. Then bring the upper ski into the snowplow position, shift your weight to the upper ski and turn until the V points straight down the slope. At this point you start to bob up so that the knees straighten, after which the weight of the body on the skis is reduced as the knees again bend. When the skis are partly unweighted in this way, they are brought parallel and at the same time the body is twisted in the direction of the turn. Remember that the body was "wound up" in the opposite direction when the turn started. During the second or skidding half of the turn, the skis are edged somewhat toward the outside of the turn. Properly executed, the stem christie will turn the skier, but does not reduce the speed greatly. Hurrying the turn will produce more side skid and will ruin the rhythm of the turn.

In all turns made at speed it is necessary to lean well inward during the turn as shown in the photo marked high-speed christie—just like an ice skater or bicycle rider. This keeps the center of gravity over or even inside of the skis, and assists the



skidding action so important to skiing turns. An up-and-down or bobbing movement is used to unweight the skis and facilitate their turning. To demonstrate how weight is apparently reduced when bringing the body down by bending the knees, do this on a bathroom scale and have someone observe the reading.

One should never run a steep hill until turns have been mastered, and then they should be used constantly to retain control. It's a good idea to stay on one slope until all humps and hollows are known to the skier and can be taken successfully in full stride. Then run a new slope, for example one of the kind shown in Fig. 7, which may require a moderate speed. Make use of all well practiced turns in choosing the proper course. The well kept stretches of a hilly golf course make excellent practice slopes.

Waxing skis: To obtain a slick surface on your skis, there must be a good base for



the running wax. The base may be a wax penetrating into the wood fibers, or several light applications of lacquer rubbed down between the coats. A thick coating is not necessary or desirable. For best results, skis should be waxed each day they are used. Usually four or five varieties of wax will meet the demands made by various snow conditions. Remember that racing

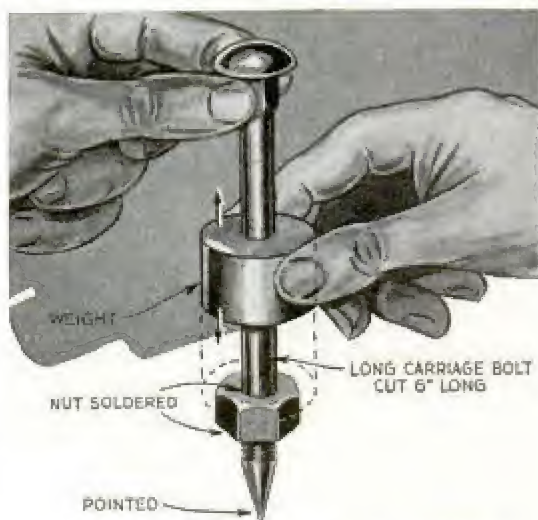
waxes are made for racing only, and will make walking and climbing very difficult if not impossible. Stick to the generally useful climbing-and-running waxes.

Ski boots: In making turns, great strain is placed on the boots as well as the bindings. The thick, straight-sided soles of the boots should fit the toe irons snugly. Small metal plates screwed to the edge of the soles as shown in Fig. 10, prevent the irons from gouging the leather. When the binding is adjusted to the boot properly, there must be no lost motion between the boot and the ski. The position of the strap or cable where it fastens to the ski will allow the heel to move up and down, as occurs in walking and in making some turns. The boots must be sturdy and must be kept in the best condition if they are to stand the strains of 6 and 7-ft. skis.

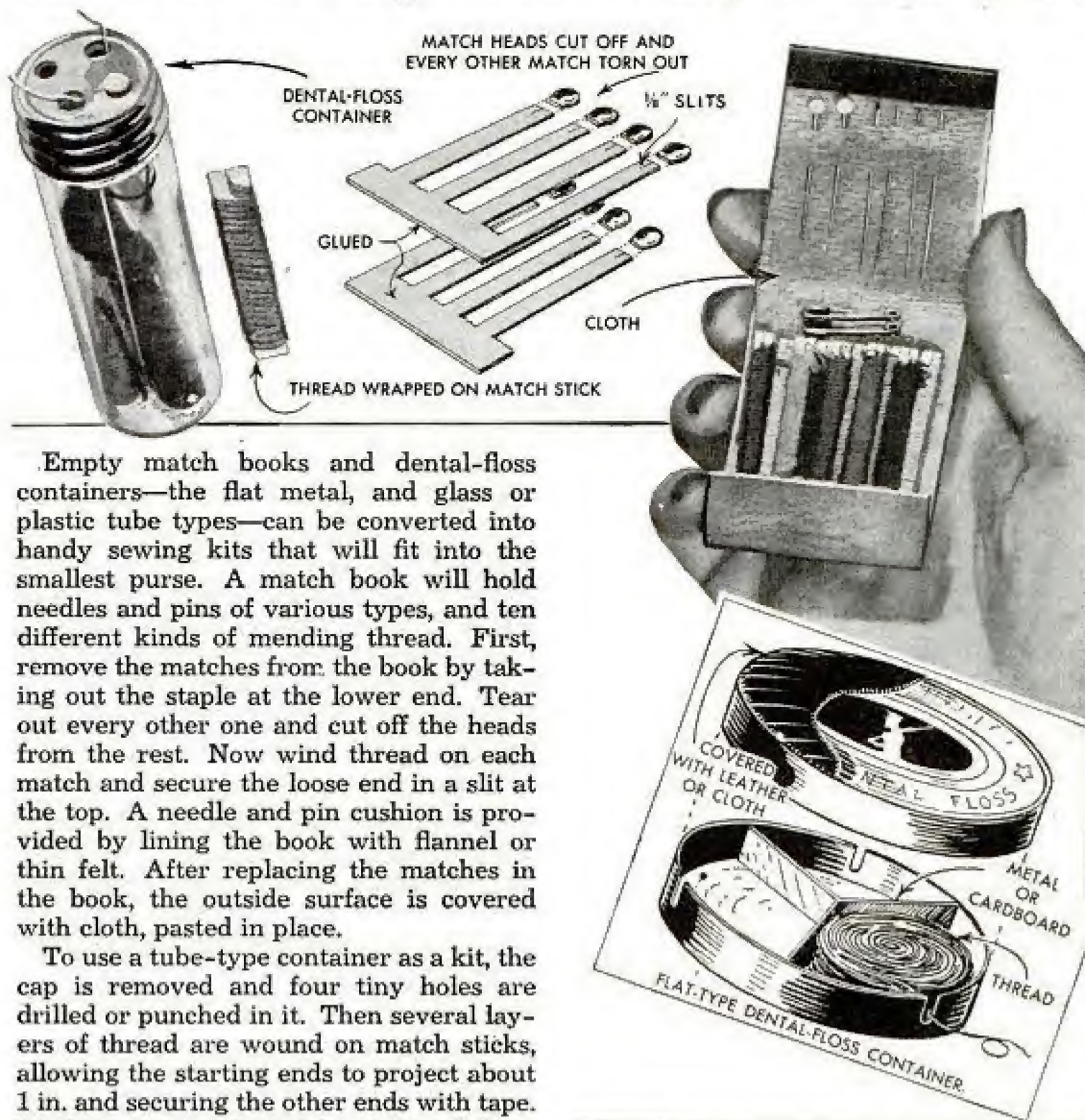
Punch Marks Metal Uniformly Without Using Hammer

This prick punch, which provides a speedy method of laying off patterns on sheet metal, can be made quickly from a long carriage bolt. The threaded portion of the bolt is first reduced by grinding off some of the threads after which a loose-fitting weight is made to slide between the bolt head and nut. Grinding or filing the end of the bolt to a sharp point completes the tool which is used to make uniform impressions by lifting and dropping the weight instead of hitting the punch with a hammer.

❑ If the sweetness of cream is doubtful, a pinch of salt will prevent curdling, even if you should use the cream in hot coffee.



Miniature Sewing Kits to Carry in Your Purse



Empty match books and dental-floss containers—the flat metal, and glass or plastic tube types—can be converted into handy sewing kits that will fit into the smallest purse. A match book will hold needles and pins of various types, and ten different kinds of mending thread. First, remove the matches from the book by taking out the staple at the lower end. Tear out every other one and cut off the heads from the rest. Now wind thread on each match and secure the loose end in a slit at the top. A needle and pin cushion is provided by lining the book with flannel or thin felt. After replacing the matches in the book, the outside surface is covered with cloth, pasted in place.

To use a tube-type container as a kit, the cap is removed and four tiny holes are drilled or punched in it. Then several layers of thread are wound on match sticks, allowing the starting ends to project about 1 in. and securing the other ends with tape. In this way the thread is unwound from the inside of the coil, and will not ravel. The thread coils are inserted into the tube, after which the loose thread ends are pulled through the holes in the caps with the pointed end of a needle. A small pencil-lead container filled with pins and needles also can be kept in the tube. A flat type of floss container is divided into three or four sections by means of cardboard separators. The thread is wound in flat coils to fit the sections and the loose ends are fed out through small slots cut in the sides of the container as shown in the lower detail.—H. Lemberger, Chicago.

❑ To keep carrots crisp, fresh and tasty, wrap them in a wet cloth and wax paper.

Small Chain Attached to Ball Cleans Inside of Bottles

The next time you have a number of bottles to clean, try a length of small chain attached to a half of a hollow rubber ball. Put water or special cleaner in the bottle, drop in the chain and then hold the half rubber ball tightly over the bottle mouth. Shaking the bottle will move the chain around and scrape the dirt from the sides.



Wire Rack on Top of Stepladder Holds Bulbs While Changing



Bent from a length of wire, this simple rack is just the thing to hold lamp bulbs safely on a stepladder when cleaning or changing them in high fixtures. To make it, just form loops in the center of the wire to accommodate five or six bulbs and drill holes in the edge of the ladder top to receive the wire ends. As the rack is merely slipped in place, it can be removed easily.

Fence Scale Handy on a Shaper

An offset scale for your shaper will be found handy, especially when using it as a jointer. The scale can be added to a shaper fence in which the halves are moved along a slide at right angle to the faces. Cut a piece of steel rule and drill the ends

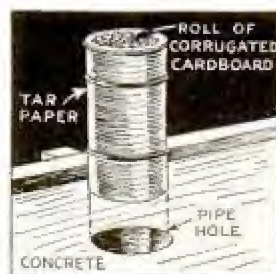


for screws so that about 1½ in. of the scale remains for use. Drill and tap corresponding holes in the casting at one side of the slide, and screw the scale to it. Also screw a metal pointer to the casting at the other side. Adjust the fence faces to accurate alignment with a straightedge and set the pointer to zero. Settings for jointing and for full-edge moldings will be easy to make.

—Edwin M. Love, Monterey Park, Calif.

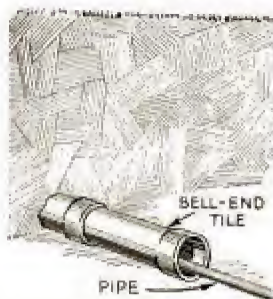
W.T.M. Concrete Roll of Cardboard in Concrete Provides Hole for Pipe

Instead of wasting time whittling wooden plugs to certain lengths and sizes to make pipe holes in fresh concrete, roll strips of corrugated cardboard to the required diameter.



A layer of tar paper is then added to prevent water in the concrete from softening the cardboard after which the roll is tied with string or held by slipping a couple of rubber bands over the ends.

Water Pipe Laid Inside Tile Is Removed Easily



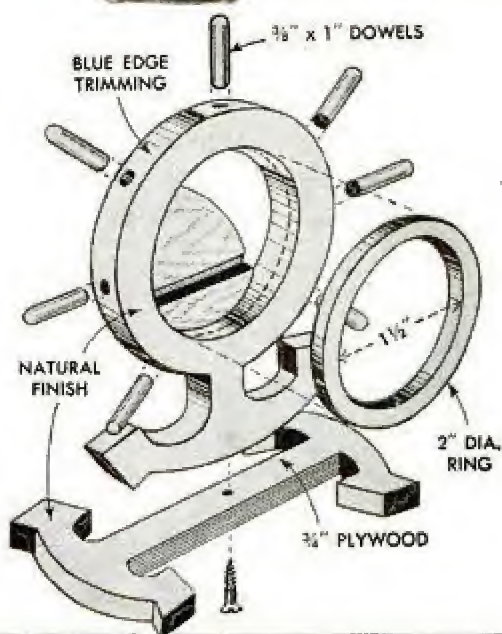
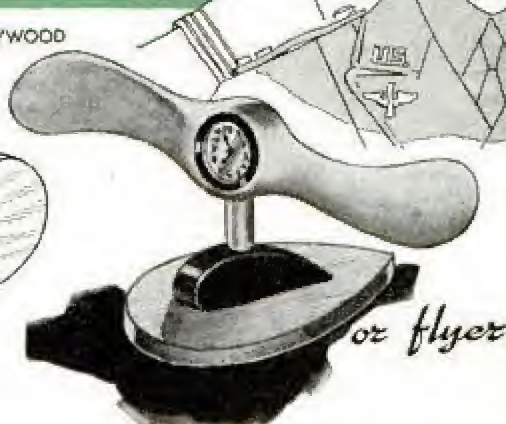
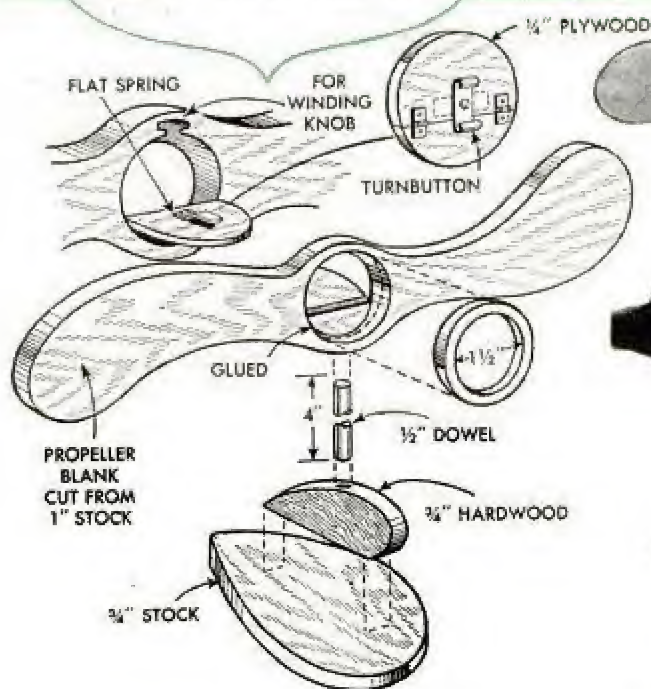
Wishing to connect long runs of pipe to the pressure water system in the basement of his house, one farmer took the precaution of laying the pipe in bell-end tile. This

made it an easy job to remove the pipe at any future time in case of freezing, leaks or for any other reason. The tile, of course, should be laid below the frost level.

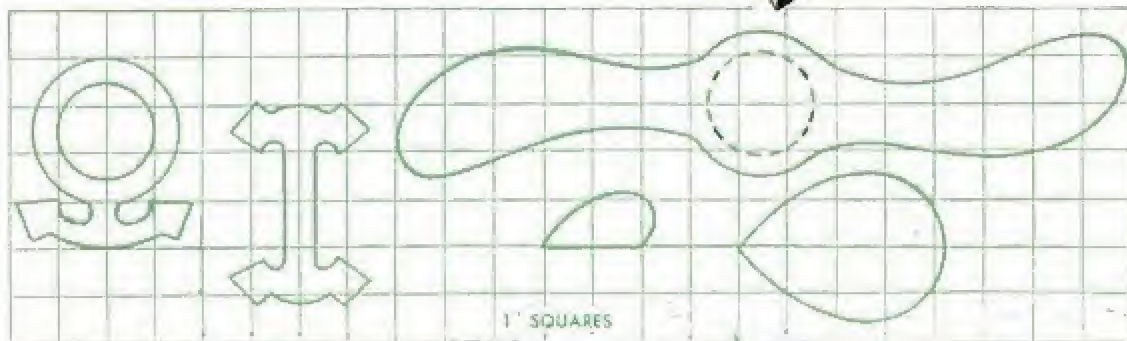
Eyelets Strengthen Model Planes

When building self-propelled model airplanes there are many places where control wires or cords have to pass through holes in the soft wood. These holes soon wear so that the wires bind. If shoe eyelets are set in the holes, wear will be avoided, and the controls will work freely.

Novelty WATCH CASES



Ideally suited as gifts for sailors or aviators, these attractive cases utilize pocket watches as timepieces that can be removed instantly. If desired the cases can be enlarged to take electric or spring-wound clocks installed permanently. Walnut, maple or other close-grained hardwood is best to use for the purpose. A maple case with a walnut or plastic retaining ring at the face of the watch gives a pleasing effect. Or, you can make the base of one wood and the upper part of another to give contrast in color



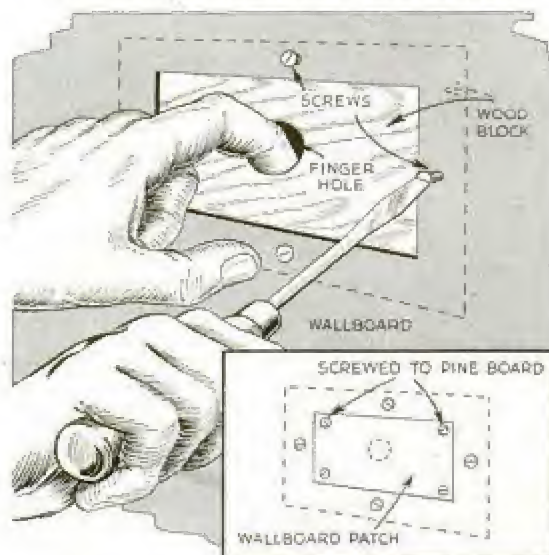
Paper Trimmer Makes Inside Cuts With Aid of Curved Block



Straight inside cuts in celluloid, cardboard, fiber or heavy paper can be made accurately by using a paper trimmer and a wood block having a curved top surface. The curved block is fastened to a thick base, which permits the material to be fitted closely over the curved surface without kinking or breaking where it contacts the trimmer board. You will find this jig helpful when you wish to cut photo frames or transformer, choke coil or magnet insulating forms.

—W. C. Wilhite, Carlinville, Ill.

How to Patch Holes in Wallboard So They Cannot Be Noticed



Next time you have to patch a hole in wallboard, try this easy method of repairing the damage. First, cut a patch slightly

larger than the hole, place it over the opening and mark around it. Then, remove the excess wallboard carefully to assure a neat fit. A pine block is next cut to fit behind the opening as shown, a finger hole being used to hold it in place while fastening with screws. Now, you are ready to apply the patch, which is screwed to the pine block, completing a repair job that will not be noticeable after the wall is again papered.—Opie Read, Jr., Chicago.

Handle From Poultry Leg Bands Dresses Up Old Purse



Linked together as shown, poultry leg bands make a strong, attractive handle to dress up an old pocketbook or to replace a worn handle. A double link chain is most suitable, however, a single chain may be used. A single band on each end of the chain serves as a fastener.

—Benjamin Nielsen, Aurora, Neb.

Effective Way of Keeping Baby's Bed Clothes in Place

Fastened to the sides of a crib and clipped to the baby's bed clothing, a pair of men's garters are ideal for keeping the clothing in place. The garters allow the baby to move freely, yet prevent it from kicking the clothing out of place. Also, the elasticity of the garters prevents tearing the bed clothing.



Novel Photo Effect Resembles Stone Carving



One of the novel photographic effects that can be produced easily by any amateur is the "bas-relief" or "sculptured" picture which closely resembles a carving in stone. Starting with any negative, such as the one of the boy whittling, Fig. 3, a positive film, Fig. 2, is made. This is done by placing a piece of commercial antihalo film behind the negative in a printing frame or on a contact printer and exposing it to a weak light. Some experiment may be necessary to get the proper density in the positive. Next, the negative and the positive films are placed together, slightly out of register, and a print such as the one shown in Fig. 1, is made by contact or projection. The two films can be held together with a couple of pieces of photographic tape while the print is being made.

—Fred G. Korth, Chicago.



Jingle of Small Bell Aids in Making Animal Look Alert for Photo

Photographers taking pictures of dogs, cats, horses or other animals often are confronted with the problem of getting the animal to look alert as the shutter is snapped. Almost any unusual noise heard by the animal will accomplish this. One of the handiest things to use for this purpose

is a small bell. After getting the camera all set and focused, and the animal in the position desired, give the bell a jingle. It's surprising how this will cause the animal to raise his head, prick up his ears and assume an alert look. Be ready to snap the shutter when you ring the bell.

Extra Socket on Flood Reflector Aids in Taking Flash Shots



Mounted near the bottom edge of a photoflood reflector, an auxiliary socket aids in taking indoor flash shots. By using the regular flood bulb for focusing, then mounting the flash bulb in the same position, you can get the lighting effect desired. The extra socket, wired to the flood-bulb switch, is mounted on a small metal bracket, which is bolted or riveted to the reflector. After focusing, the flood bulb is turned off, the flash adapter plugged in and the flash bulb fired by closing the switch.

—Joseph A. Nemeth, Chicago.

Short Lengths of Movie Film Printed in the Camera

Almost any 16-mm. movie camera can be used as an emergency printer. In the darkroom, load a daylight spool with the

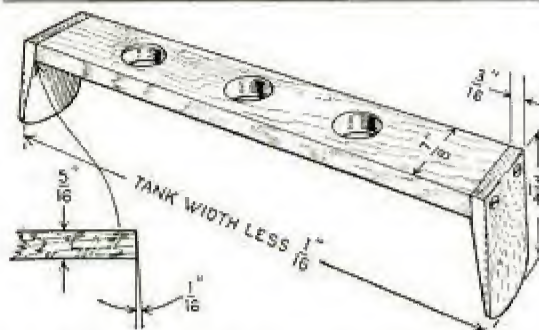
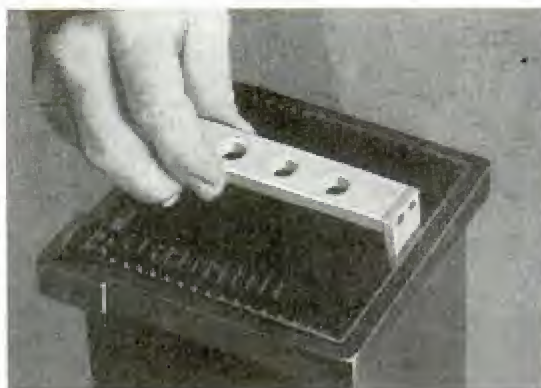


negative and the positive stock, winding them on the spool together with the emulsions facing and the positive stock back of the negative. Thread the two films through the camera sprockets together. Then point the camera at a brightly illuminated white card, with the diaphragm wide open, and start the camera running. A few tests will determine the correct amount of light to use on the card. After exposure, the positive film can be removed and developed in the usual manner.

—Louis Hochman, Brooklyn, N. Y.

Substitute for Tank Hold-Down Made of Wood and Glue

When the plastic hold-down strip from my cut-film developing tank was broken accidentally, I made a satisfactory substitute of wood. The wood strips were shaped and sanded, then screwed together and the



whole assembly given a heavy coat of waterproof plastic glue. The glue was allowed to dry for a week at room temperature, but was sanded smooth after two days of drying.—E. M. Love, Monterey Park, Calif.

One photographer, who had some water-colored photos to mount on cloth backing, found the colors would not run if the prints were dipped in vinegar instead of water before pressing them on the cloth.

Small Motor Drives this

FILM-TANK AGITATOR

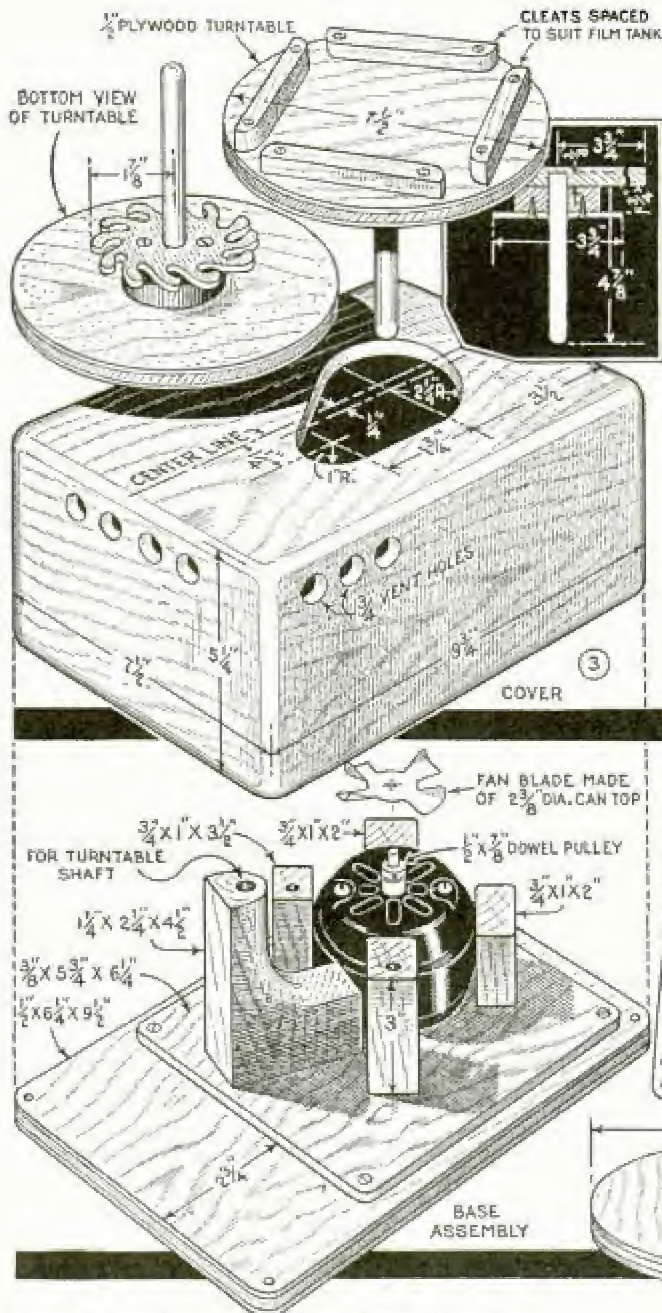
Escapement-wheel action gives pulsating, rotary motion to agitate solution thoroughly. Utilizes motor of small fan and wood from scrap box

By Edwin M. Love

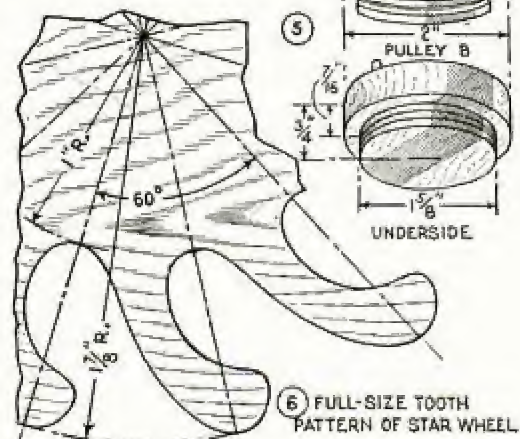
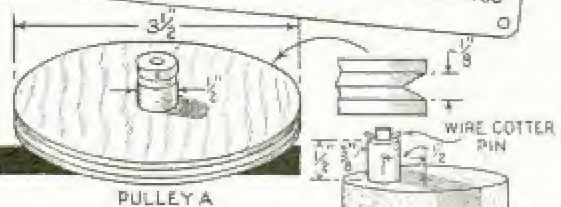
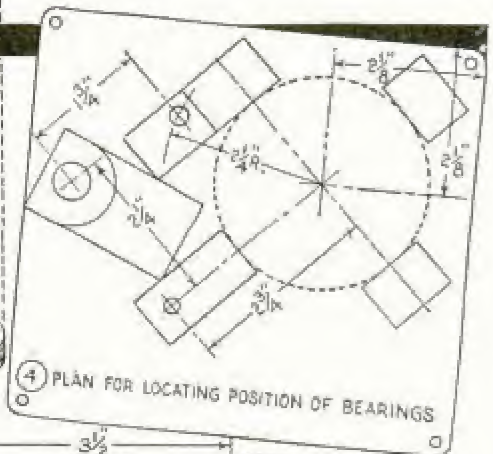
ACTUATED like the escapement wheel of a watch, the turntable of this efficient agitator rotates the film tank in a jerking manner to keep the developer moving continually. Cleats on the turntable form a well in which you set the tank as shown in Fig. 1. Construction centers around a small fan motor, which is stripped of its base and fan. A piece of $\frac{1}{2}$ -in. dowel, drilled centrally and grooved, is pressed on the motor shaft to serve as a pulley and to take up thrust when the motor is stood on end. Excessive heating of the motor can be prevented by providing it with a small fan. A suitable one can be cut to shape from a can cover and soldered to the end of the motor shaft. Fig. 2 shows the arrangement of the pulleys which, when belted together, will rotate the turntable at about six revolutions per minute. Flat shoelaces, stitched end to end, will do for belts. Regular belt dressing can be applied if slippage occurs. The detail to the left of Fig. 4 shows how the motor nests between wood blocks, two of which serve as bearings for the pulleys and turntable. Location of the blocks as given in Fig. 4 is for a motor of 3-in. diameter or less and dimensions should be increased proportionally when using a larger one. Large pulley A is turned from a piece of plywood and has a short piece of dowel glued to the center of it for a second pulley. Both could be turned in one piece from a 1-in. disk.



Tiny fan cools motor by forcing air upward and out vent holes in cover



of the agitator. Fig. 6 gives the tooth pattern full size for tracing on a piece of hard-pressed board. When fitted properly, the crank roller will slip in and out of the slots, jerking the tank around by giving it a slight backward kick each time. If you find that the roller does not mesh smoothly with the teeth of the star wheel, experiment by reducing the size of the roller and by shifting its position slightly on the pulley. When adjustment is completed, a cover can be made like the one in Fig. 3, to set down over the mechanism. It is advisable to paint the cover to protect it from spilled solution. Agitation can be increased if desired by placing a block under one end of the base to tilt the turntable.



Round-head wood screws about 2 in. long will do for the pulley shafts. Pulley B, carrying the crank pin, which is simply a headless wood screw, turned in with pliers, is made of solid stock as detailed in Fig. 5. A piece of dowel bored to slip loosely over the pin, acts as a roller to engage the teeth of the star wheel on the underside of the turntable. Fig. 3 details the latter, showing top and bottom views and the manner of attaching the dowel shaft over which the star wheel is fitted. Light grease should be applied to the dowel to make it turn easily. Accuracy in laying out and cutting the wheel determines largely the efficiency

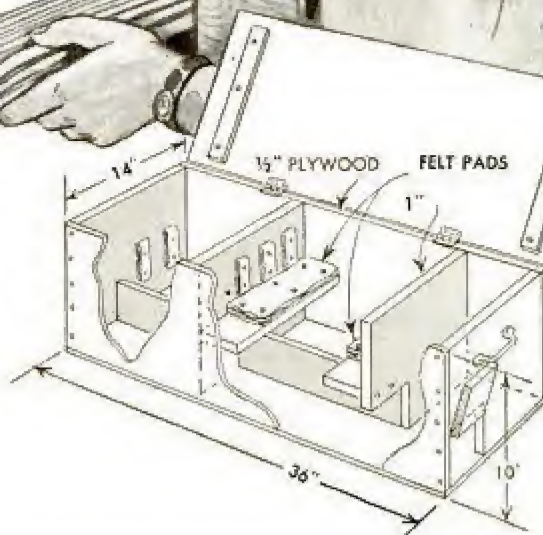
Carrying Cases for Photographer's Equipment



All your equipment is carried safely and at your fingertips when you go out on a job with these two cases



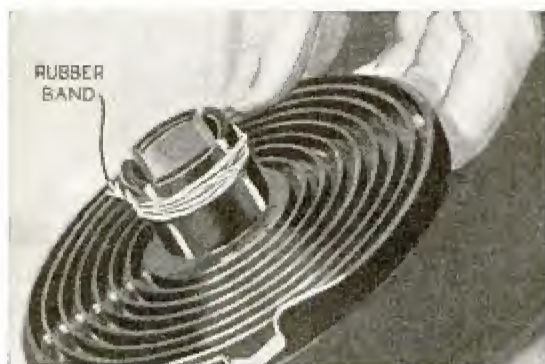
Any photographer who must carry his equipment in a car will find these two cases ideal for the purpose. One is a plywood box partitioned to provide compartments for a camera, tripod, accessory box, etc. The camera and accessory-box compartments have thick felt pads to absorb road shocks and protect delicate mechanisms. Carrying handles are provided at the ends, and the lids for both the box itself and the tripod compartment are hinged. The dimensions and compartment arrangement can be changed easily to provide a box suitable for your particular equipment. If the box is to be carried in a car trunk or rear-deck compartment of a coupe, a couple of small casters located near the two front corners will facilitate sliding the box in and out. The other case shown in the photo is merely an inexpensive overnight bag partitioned



to provide compartments for film holders, boxes of film, exposure meter, sunshade and changing bag. Strips of cloth tacked inside the lid provide pockets for note books, lens filters and other small parts.

—J. E. Priestley, Fresno, Calif.

Rubber Band on Tank Reel Locks It Securely in Position



After considerable use, the friction catches on a plastic film-tank reel sometimes become worn to the extent that they will not hold the reel in adjustment for films of different sizes. Usually a quick and effective repair can be made with a rubber band. The band is wrapped around the reel, as shown.

Save pieces of tinfoil from cut-film packages and shellac them to a piece of wall-board to make a handy light reflector.

Old Hypo as Short-Stop Bath



When you are out of acetic acid, you can use your discarded hypo as a substitute for the short-stop bath. Hypo that is too exhausted for use as a final fixer will still

neutralize the alkalinity of the developer on prints submerged in it and fix them slightly, leaving less work for the final bath and helping to make it last longer.

Film Stored in Battery Covers

Cardboard covers from flashlight batteries are handy for storing lengths of 35-mm. film. There is sufficient blank space on most of the covers to write the necessary data.

Don't use a case from a battery that has corroded, as the corrosion might damage the film. To be safe, dip the cases in melted paraffin before they are used.



WHAT KIND OF BOAT DO YOU WANT?

Whether it's a simple rowboat, an outboard runabout or a family cruiser, you'll find something you want among our plans. Build your boat now for the coming season



"Banta," 12-Ft. Runabout—1080-1081

"Banta," 12-Ft. Plywood Runabout—1080 and 1081: Simplified construction makes this plywood runabout easy to build. Here's the boat to take along on that weekend trip. 2 prints 50c.

"Falcon"—1070-1079 Incl.: Trim, sturdy 18-ft. inboard runabout or cabin cruiser. 66 in. beam, 42 in. total depth, 7 or 8 passengers. Makes a speed of about 17 m.p.h. with a 20 h.p. motor. 10 prints, material list and procedure \$2.50.

CATALOGUE OF PLANS

If you have a home workshop and want some new ideas on things to build, just send your name and address with a 3c stamp for our new 32-pp. illustrated plan catalogue. Lists plans on workbenches, motor-driven machines, garden furniture, models of all kinds, boats, radio equipment, juvenile articles, etc.

"Arrowhead" Sloop—944 to 951: 21-ft. sailboat that can be built by average craftsman. Accommodates up to 10 passengers. Set of 8 prints \$2.00.

"Hi-Ho," 14-Ft. Family Runabout—840 to 845: Powered by 11 to 22 hp. outboard or light inboard motor. Beam 58 in. Set of six prints \$1.50.

"Roamer"—765 to 770: Outboard cabin cruiser. 16 ft. long, 66 in. beam. Requires outboard motor of 20 to 36 hp. Set of six prints \$1.50.

"Skipper"—1018 to 1023: Low-cost, outboard runabout. Can be built for \$30 to \$40. 14 ft. long, 54 in. beam, weighs about 275 lbs. Set of six prints \$1.50.

12-Ft. Rowboat—707: Flat bottom. Can be used with small outboard motor. 25c.

"Sea Saucer"—893: Lightweight sailboat. Length 9½ ft. Planked with 3/16-in. plywood. 25c.

16-Ft. Canoe—811 and 812: Cedar planking covered with canvas. Two prints 50c.

Canvas-Covered Kayak—928 and 929: Light framework covered with canvas. 17 ft. in length and accommodates single passenger. Two prints 50c.

7½-Ft. Plywood Rowboat—1068: Made from waterproof plywood this boat is easily transported on top of car. Complete instructions and material list included. 25c.

Popular Mechanics Magazine, Dept. 441, 200 East Ontario Street, Chicago, Illinois



SHOP NOTES

Built-up **POLISHING WHEELS** *made from cloth buffers*

How you can make your own metal-polishing wheels by gluing cloth buffers together and coating them with powdered abrasives

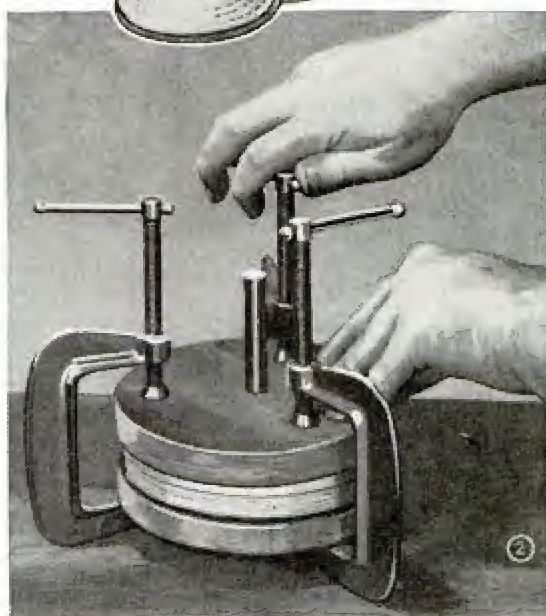
By Alexander Maxwell

USED progressively, from coarse to fine, these inexpensive polishing wheels enable you to produce a high luster on practically any kind of metal, as well as glass and stone. Fig. 10 gives a list of materials and the number of different-grit wheels required to finish each from rough to high polish. You'll notice that some metals can be brought to a high polish more quickly than others, as in the case of stainless steel as compared to brass castings. Note too that in a number of cases wheels of one grit will do for two or more different metals.

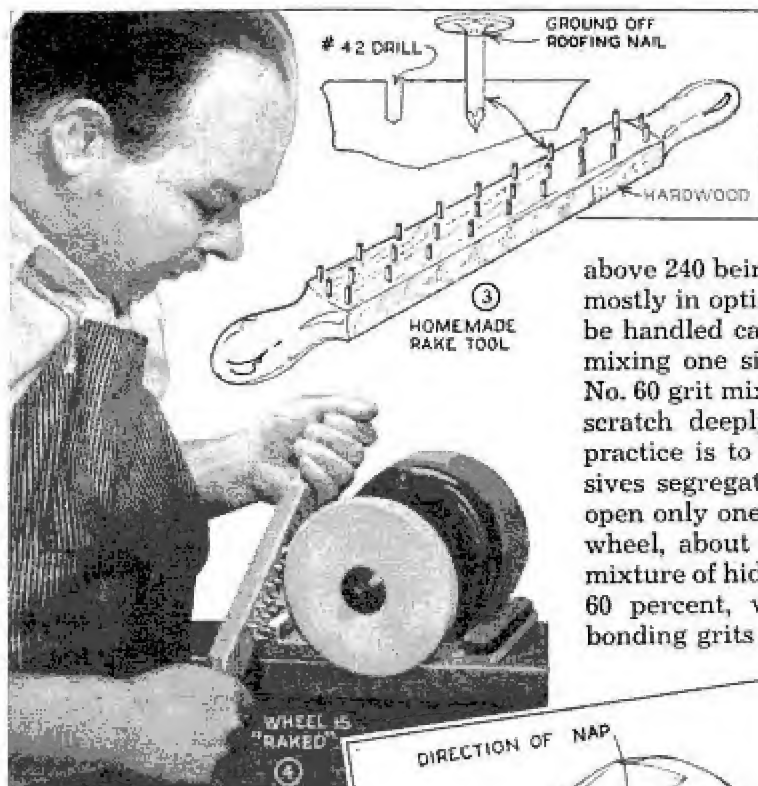
The best buffers to use in building up these wheels are the stitched $\frac{1}{4}$ by 6-in. size. Only hot, hide glue should be used in gluing the buffers together face to face as shown in Fig. 1. Resin-type glue should be avoided as it becomes too hard and is apt to scratch the work. For pressing the buffers tightly together, you'll need a cou-



①



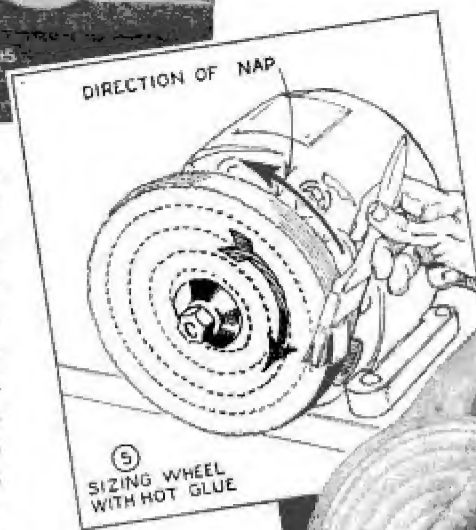
②



ple of 6½-in. wood disks, one being bored to take a piece of steel rod tightly, and the other to slip over the rod loosely. These disks are dipped in paraffin or the contacting surfaces are covered with waxed paper to prevent sticking. In using hot glue, you must work fast to keep it from jelling before clamping pressure can be applied as shown in Fig. 2. Five buffers will make a good, solid wheel about 1 in. thick when clamped. Allow at least three days for the work to dry, removing it from the clamps after the first day and setting it aside in a warm, dry place.

Before the wheel can be charged with abrasive it must be dressed or "raked" as in Fig. 4. For this you'll need a tool like the one shown in Fig. 3. Hold the tool lightly against the rotating wheel and work it back and forth from side to side. This will produce a flat nap. Trim the wheel of any stray threads or strings and then size it with hot glue as shown in Fig. 5. Indicate direction of the nap on the side of the wheel and always mount the wheel to run with the nap. Then you charge the

wheel with abrasive. Emery powder can be used, although for fast cutting and long life abrasives such as aluminum oxide and silicon carbide are preferred. Grits are graded by number, those above 240 being known as "flour" and used mostly in optical work. The abrasive must be handled carefully to avoid accidentally mixing one size with another, as a single No. 60 grit mixed with a No. 120 size would scratch deeply and mar the work. Safe practice is to keep the various-size abrasives segregated in screw-top jars and to open only one at a time. To charge a 6-in. wheel, about 2 oz. of grit are needed. A mixture of hide glue, 40 percent, and water, 60 percent, will make a good glue for bonding grits of 60 to 70 size. Larger grits require a thicker glue and finer ones a thinner glue. In finishing with fine-grit wheels, a thick glue would soon glaze the wheel and gum the work. Fig.



⑦ Correct proportions of glue and water for various grades of abrasives

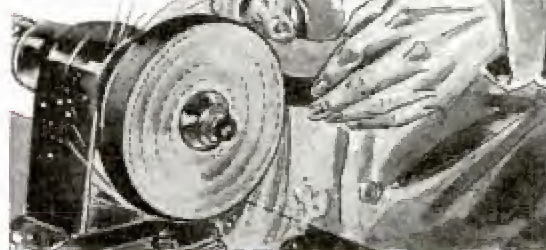
Size of grain	Glue	Water
24-36 - - - - -	50 percent	50 percent
46-54 - - - - -	45	55
60-70 - - - - -	40	60
80-90 - - - - -	35	65
100-120 - - - - -	33	67
150-180 - - - - -	30	70
220-240 - - - - -	25	75

7 gives correct proportions to follow. Mix the glue and water by weight and make up just enough to do the work at hand. Soak overnight and then heat in a double boiler or a regular glue pot.

To charge a wheel, which should be done immediately after you coat it with glue, grasp it as shown in Fig. 6 and bring it down sharply and squarely on a small pile of abrasive placed on a clean sheet of paper. On the "rebound," turn the wheel a little and bring it down again. Repeat until the periphery is completely coated. Now place the wheel in an oven for an hour, after which you apply a second coat of glue and recharge as before. Then set it aside for three days to dry. Any abrasive remaining on the paper should be put back into its jar. The paper should be discarded and your hands washed thoroughly before handling grit of another size. Next, the coated edge of the wheel is broken by striking it with an iron rod as shown in Fig. 8. If it does not crack readily and only dents, it is not yet thoroughly dry. Cracking the wheel gives a springy cutting edge, resulting in a combined wiping and polishing action. Final step is to dress the cracked edge with a piece of broken grinding wheel as in Fig. 9. Use care in doing this and bear lightly to cut down the high



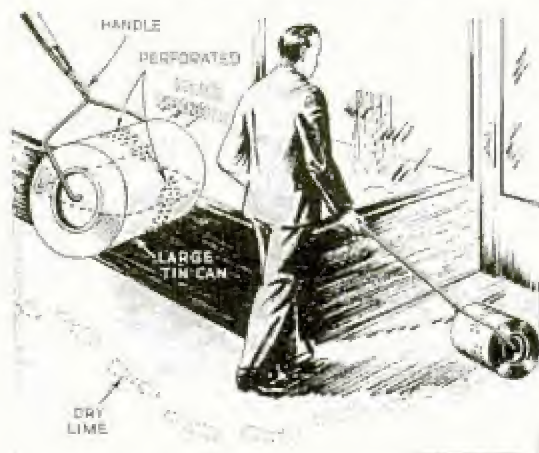
9
COATED SURFACE
DRESSED WITH
PIECE OF
GRINDING WHEEL



spots. When the wheel must be recharged, this method is used to strip off the old edge down to the bare cloth. You'll find that the wheel will cut more smoothly if it is charged also with cake pumice. Hold the pumice against the wheel as in Fig. 11, until the surface is white and only the top of the abrasive grains are visible. Some work polishes best with a dry wheel, but other work must be lubricated. For this, a tallow stick applied as in Fig. 12 is convenient to use, although beeswax, paraffin, lard and axle grease also will do. In polishing rough work, use the coarsest wheel just long enough to break down the surface, then switch to the next finer one. Use this one until the marks of the first wheel have been removed and change to a still finer one. Hard metals cut slowly and often come to a high polish with a relatively coarse wheel. The softer ones usually must be polished further by buffing with a cloth wheel charged with either tripoli or whiting.

⑩ Grain of Abrasives for Polishing Various Materials	1st	2nd	3rd	4th	5th
Axes, hammer heads, scythes, plowshares, shovels, wrenches, steel forgings	46	70	120	180	
Sand-cast aluminum	60	120	Buff		
Die-cast aluminum	150	Buff			
Sheet aluminum	120	180	Buff		
Saw steel, knife blades, cutting tools, dies, jigs, fixtures	60	120			
Sheet brass	180	Buff			
Brass castings	60	180			
Grey iron	80	120			
Monel metal	120	150	180	Buff	
Cast monel metal	80	120	150	150	Buff
Stainless steel (mirror finish)	80	120	150	220	Buff
Stainless steel (commercial)	80	100	120	150	
Glass beveling	90	150	220	Pumice	Rough Buff tin oxide
Stone polishing	60	150	280	320	

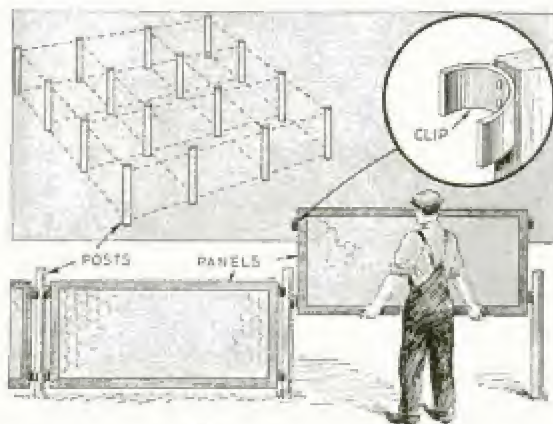
Customers Directed to New Store By Lime-Dust Signs



To stimulate curiosity and direct the attention of prospective customers to a newly opened store, one advertising man used the novel method shown. A large can was pivoted to a handle so that it could be rolled along the sidewalk, the can being perforated with designs of arrows and footprints. Dry lime placed in the can sifted through the perforations as the can rotated and formed the designs on the walk.

Quick-Change Panels Form Pens That Can Be Altered Easily

Time spent in changing the size of pens for growing chickens is reduced to a minimum by one poultryman who made quick-change panels to slip between posts set in rows as shown. The panels consist of a wooden framework covered with chicken wire and fitted with metal clips on each end, which slide along the sides of the posts. As the flock grows and requires more space, size of the various pens is in-



creased by merely moving some of the panels and storing those not needed in a dry place until the next season.

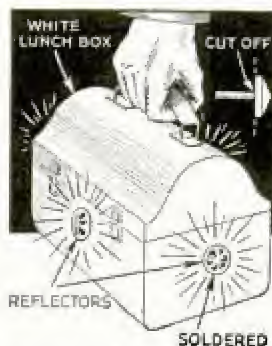
Drill Press Used to Tap Holes

In our shop we have many holes to tap but not enough to warrant the purchase of a regular tapping machine. Having plenty of drill presses we rigged up one for tapping. An auto steering wheel was fitted to the top of the spindle; by holding the tap in the drill chuck, we are able to tap easily and accurately when the wheel is turned by hand.

—O. H. Nieman, Freeport, Ill.



Small Reflectors on Lunch Box Good Safety Precaution

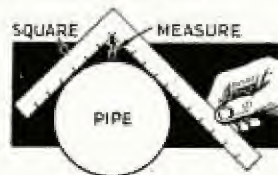


As an aid in getting through heavily traveled areas safely on foot during "dim-out" periods, one night worker painted his lunch box white and put small red reflectors on it. These reflected light

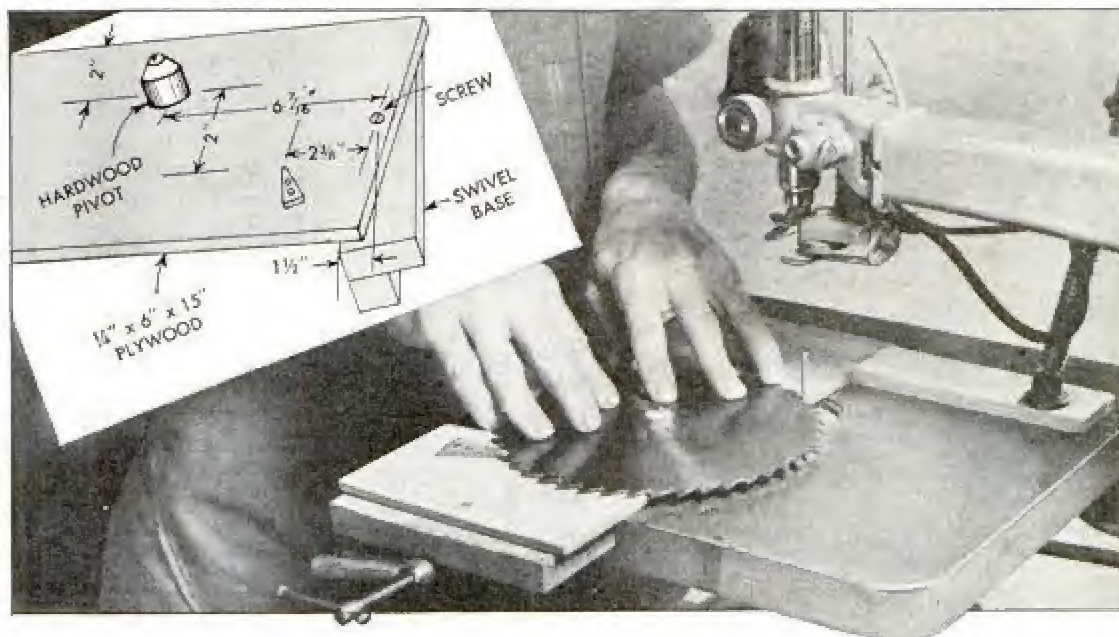
from the dimmed lamps of cars and served as a warning to the motorists.

Diameter of Cylindrical Work Measured With Square

The diameter of pipe or other cylindrical work can be measured by using a carpenter's square as shown. When placed on the work in this position, measure from the top surface of the latter to the crotch of the square and then multiply this distance by 4.8286. The result will be the outside diameter of the work.



Gumming Circular-Saw Blades on Scroll Saw



After several filings, circular saws require gumming to deepen the teeth and round the gullets. You can do this work quickly and accurately on a scroll saw by using a file and a jig like the one shown. The jig is provided with a close-fitting pivot for the saw blade, a stop which is wedged between the teeth to hold it, and a second stop, which is clamped to the saw table to limit the depth of cut. In use, a round or half-round file is inserted into the scroll-

saw chuck and the swivel base of the jig is clamped to the table in a position to permit correct engagement of the file with the saw blade. Then, running the scroll saw at its slowest speed, one gullet is filed to the desired depth, after which the second stop is clamped in position against the forward edge of the jig. To shift the teeth for filing the next gullet, the jig is pulled back slightly and the blade is lifted above the tooth stop.

Wallpaper on This Rack Is Unrolled Easily for Display

One merchant keeps rolls of wallpaper on a display rack which enables him to unroll a long strip of the paper quickly so that customers can visualize the appearance of a finished room. Although not shown, an X-brace running from top to bottom inside the rack provides rigidity.

Parts Tray for Electrician's Ladder



Here's a handy clamp-on tray for the top of a step-ladder which provides an ideal place to keep small parts when repairing or changing ceiling fixtures. It is made from an old table spoon, bent as shown.





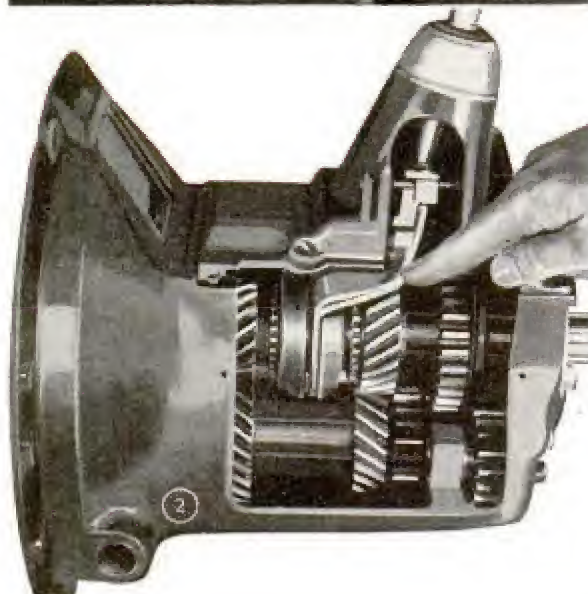
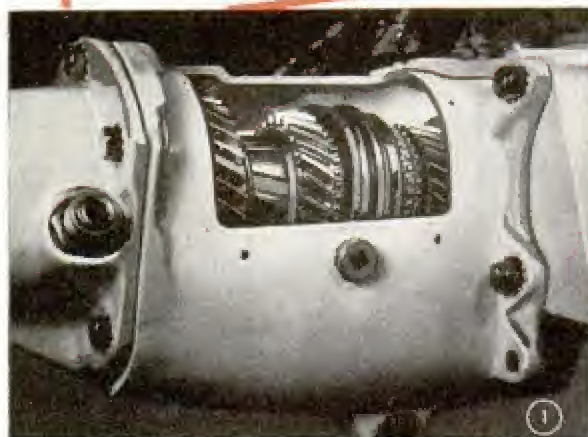
Pointers on

By C. E. Packer

CLUTCH trouble does not always mean that the clutch itself is defective, but that its operation is unsatisfactory, which may be caused by almost any part of the drive mechanism, especially the transmission. Anything that causes the transmission gears to clash when shifting them or causes the clutch to grab, throws undue strain on the gears, shafts and bearings throughout the drive system. This causes excessive wear and even breakage of the parts.

Protection of the transmission with a high-quality lubricant is vital in two ways: It reduces wear and prevents excessive clutch spin. Also, "riding" the clutch—keeping your foot on the pedal while driving—causes unnecessary wear. Light contact of the foot brings the throw-out bearing into play and exerts end thrust on the crankshaft, creating end play prematurely while slightly increased pressure on the pedal contributes to slipping, which wears out the clutch-plate lining and may damage the pressure plate as in Fig. 3. There is no wear of any kind on the clutch when no pressure is applied on the pedal.

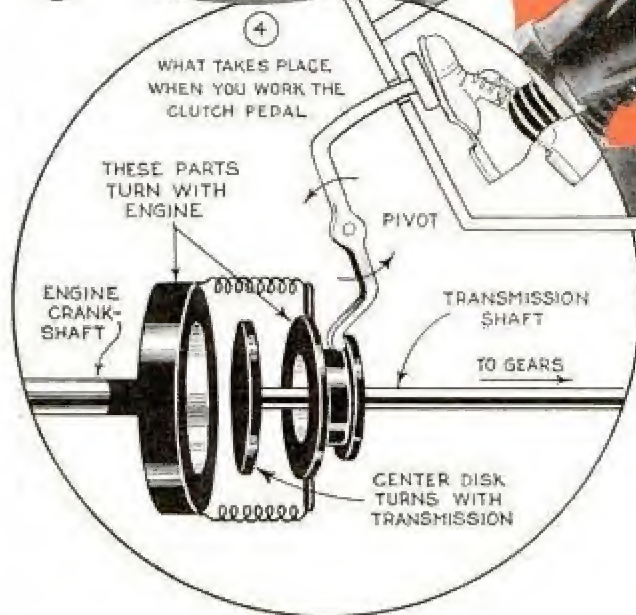
In order to shift gears noiselessly, the engaging gears should be running at approximately the same speed. Even when shifting "syncromesh" transmissions, having the parts to be united operating at similar speed is desirable. Therefore, the center disk that turns with the transmission is made as light as possible. This, in conjunction with the predetermined drag of the lubricant, brings the clutch to rest quickly when the foot pedal is depressed. Insufficient lubricant or lubricant with too light a body allows free spinning of the clutch, which contributes to wear in several parts and to difficulty in shifting. If lubricant of the proper kind as recommended by the manufacturer, is kept up to the bottom of the inspection-hole plug shown directly below the transmis-



CLUTCH CARE



3



4

WHAT TAKES PLACE
WHEN YOU WORK THE
CLUTCH PEDAL

THESE PARTS
TURN WITH
ENGINE

ENGINE
CRANK-
SHAFT

CENTER DISK
TURNS WITH
TRANSMISSION

TRANSMISSION
SHAFT

TO GEARS

PIVOT



sion opening in Fig. 1, little trouble will be experienced. When gears have a tendency to slip out of mesh, the cause may be wear or a sprung shifter fork, as indicated in Fig. 2. When the fork is sprung, the gears of the old-type transmission or the synchronizing unit of the modern transmission are not moved far enough to mesh correctly.

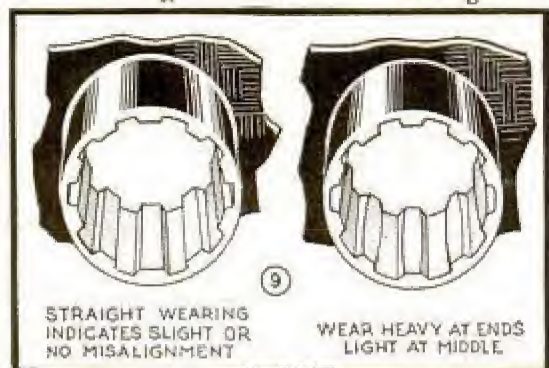
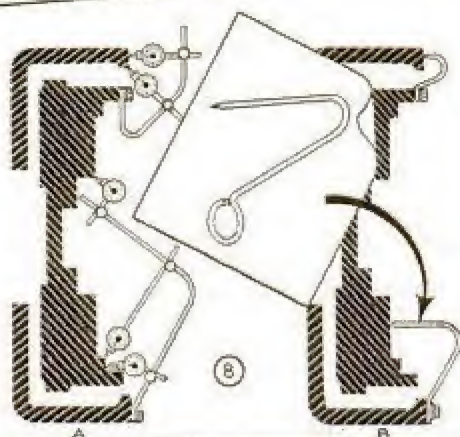
Wear in the throw-out mechanism of a clutch should be adjusted promptly. If it is not done, the clutch may drag or slip, with the result that gears or synchronizing parts cannot come to rest or will not function properly. Few clutches have any adjustment within the clutch housing. Most adjustments are made by some combination of screw-and-bolt linkage between the pedal and the clutch shaft. A typical example is seen in Figs. 6 and 7. Here the pin at the lower end of the screw adjust-

ment is removed, and the adjusting clevis screwed in or out as necessary to give the clutch pedal a free travel of about 1 in. before it acts on the clutch mechanism. Lacking this free travel, the throw-out bearing will be in continuous operation, causing increased wear, which will result in immediate and serious slipping.

With the demands for quieter operation, engine mountings have been made softer and in some cars the engines are free to move considerably.

Therefore, the power pulsations from the engine are transmitted through the clutch. Consequently, when engine movement becomes excessive due to matting down or weakening of its supports, strains on the clutch become greater and trouble results. Sometimes clutch trouble has been stopped by replacing or tightening the engine mountings. In the case of chronic clutch chatter, a general tightening of the chassis often has proved effective. When we realize that the full power of the engine is transmitted through a clutch disk no larger than a dinner plate, it will be appreciated that any jerking resulting from looseness in the drive line can break momentarily the grip of the clutch, and cause a slight slip, which in itself is not serious but causes wear on the clutch facings over a period of time.

Looseness of rear-wheel hubs on axle



shafts, or even looseness of the wheels on hubs over a period of time may cause clutch trouble. Also, excessive play between the pinion and ring gear within the rear axle, or between the differential side gears and the axle shafts, may result in trouble often diagnosed as a faulty clutch. And, any looseness in the driveshaft either in its splines or

at the universal joint, may be the cause of mysterious clutch difficulty.

The nuts on the clutch fingers seen through the clutch inspection opening in Fig. 5, should be adjusted only by manufacturers who have precision fixtures for the purpose. The fingers can be seen in more detail in Fig. 3, this clutch having six fingers, all of which must be at exactly the same height. When the complete clutch pressure plate is assembled at the factory, all of the ten or more springs, and six or more fingers are checked accurately. In time, the springs may become weakened and cause trouble, but if any attempt is made by an inexperienced person to compensate for this condition by adjusting the clutch finger nuts, slipping or grabbing is almost certain, with the result that further damage will be done.

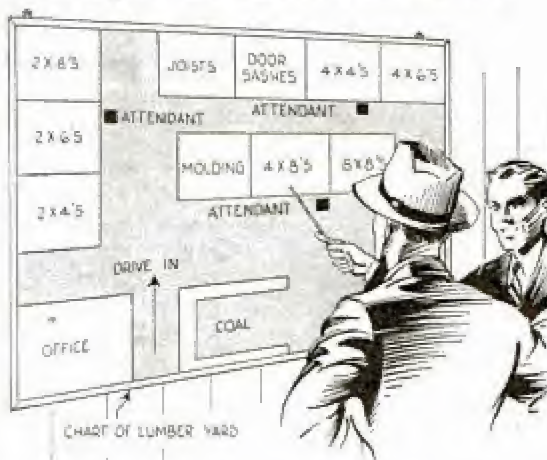
In cars that have a torque-tube drive (tubular housing covering the torque tube between the transmission and rear axle), careless handling of the car may cause clutch trouble. For example, should an owner of such a car back up against a solid object, the impact would be transferred directly to the rear end of the motor, which is the clutch housing. This could cause misalignment between the clutch housing and the flywheel. Detail A of Fig. 8 shows the manner in which experienced mechanics check the alignment between the fly-

wheel and the clutch housing with the use of precision gauges. Detail B shows a similar check that any car owner can make when servicing his own clutch. By taking a length of stiff wire bent to the shape shown, it will be possible to check "run out" of the flywheel. If the "run out" exceeds .005 in., the resulting misalignment between the clutch housing and the transmission will cause excessive wear of the spline in the hub of the clutch plate, Fig. 9. Often, by tightening one flywheel bolt slightly more than another, this condition can be corrected within reasonable limits. A squealing noise within the clutch may indicate that the bearing supporting the front end of the clutch shaft is in bad condition, or that the throw-out bearing is running dry. While some throw-out bearings have provision for lubrication, many of them are lubricated for life.

One of the most disturbing clutch actions results from lack of lubrication of the pedal shaft or some related part. Under such conditions, the clutch may stick temporarily, then take hold suddenly. Naturally this throws tremendous strains on all parts of the car. This condition is particularly likely to develop in cars that are operated where salt is distributed on pavements to thaw the ice. The judicious use of penetrating oil on all moving parts that enter the clutch housing, which is done while moving the clutch pedal in and out, will clear up this trouble. Any tendency of the pedal to rub on the side of the opening where it passes through the floor of the car may cause trouble.

Speaking of jerking operation, it may seem far-fetched to point out that faulty use of the choke can injure the clutch, but such is the case. The jerking action of an engine that is operating on too rich a mixture (or missing for any other reason) causes strain on the clutch. Another thing that is responsible for clutch difficulty is the use of too light a lubricant in the transmission, or too much of it, with the result that some may work forward onto the clutch and cause slipping or grabbing. A loose rear main bearing in the engine may also cause this trouble by allowing oil to pass from the engine into the clutch. A clogged breather on the engine may have the same effect, in which case the pressure built up in the crankcase by blow-by around the pistons will force oil out of the main bearings.

Chart of Lumber Yard in Office Helps Customers Find Stock

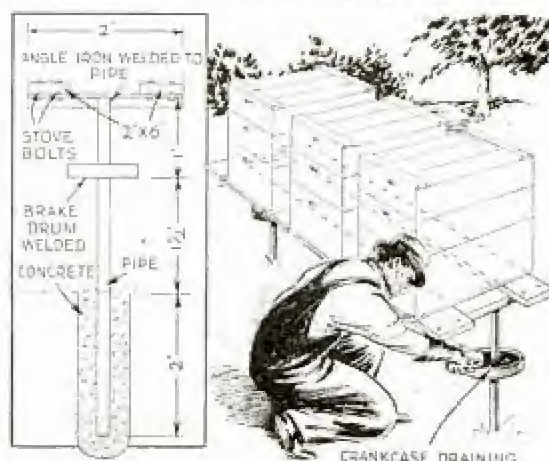


To assist his customers in locating various materials desired, one lumber dealer made a chart showing the layout of his yard. This was hung in the office near the manager's desk so that it could be used to show customers exactly where to find the stock needed and where attendants are stationed. The chart has also proved to be a big help in acquainting new employees with the layout of the yard.

Rack to Keep Crawling Insects Out of Your Beehives

Place your beehives on a rack like the one shown to keep ants and other crawling insects from getting into them. Containers on the legs are filled with oil so that insects cannot crawl up them. While the rack shown has metal legs and cross supports, these can be made of wood if desired. And other suitable containers can be used on the legs instead of brake drums.

—E. O. Cosper, Ysleta, Tex.



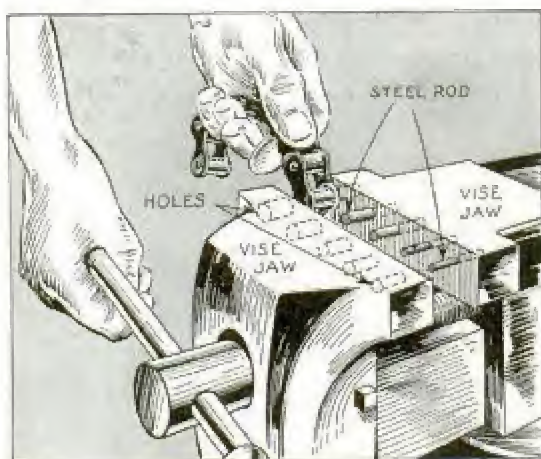
"Tarpaulin" on Basket of Bicycle Protects Contents in Rain



One grocery delivery boy keeps a cover handy at all times for the basket on his bicycle, by attaching two pieces of heavy canvas or other waterproof material to the bottom of the basket as shown. When not in use, the cover is rolled down and tied in place with shoestrings.

Vise Speeds Removal of Rivets From Roller Chains

In order to speed up the job of removing rivets from roller chains such as those used on bicycles and motorcycles, one mechanic converted an ordinary vise so that it could be used for the purpose. One jaw was first drilled to receive five steel pins of diameters that correspond with sizes of chain rivets most commonly used. Holes slightly larger than the chain rivets were then drilled in the other vise jaw directly oppo-



site the pins. In use, the chain is held as shown while the vise is tightened to force the rivets out.—J. Vick, Church Road, Va.

Whisk Broom Sprays Powder In Poultry Nests

To dust insect powder uniformly inside poultry nests, dip the bristle ends of a whisk broom in the powder and then draw them across the edge of the nest so that they whip the dust in a fine spray. This method is easier than sifting the powder from a can, and the work is done with greater economy and speed.



Unwinding of Tape Avoided By Shellac Coating



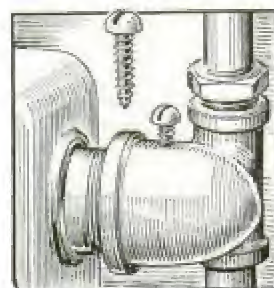
The next time you use friction tape on tool handles, wire, etc., cover it with a coat of shellac. You will find that it will prevent the tape from unwinding and will prevent it from being sticky. The

shellac also will provide a shine which will give the job a neater appearance.

Air Vent in Water Heater Sealed With Self-Tapping Screw

I was called out to service a hot-water heater that was not working and found that the system was air-locked. As there was no provision made for relieving this condition, I drilled a small

hole in a pipe fitting to remove the air. When water started to drain from the hole,



a self-tapping screw was driven into it to seal it. Since doing this, I have repaired several heaters in the same way without having any of them show any signs of leaking at the screw.—L. Tatro, Waterloo, Ia.

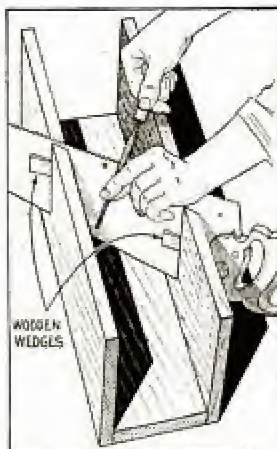
Danger Flag With Flexible Staff Rights Itself When Upset



To keep his warning flags from becoming ineffective when knocked over, one contractor fitted them with flexible staffs so that they would right themselves if struck accidentally. This was done by inserting the lower end of each staff in a coil spring, which was in turn inserted into a hole in the base.

Miter Box Holds Saw for Filing

If there is no vise available when you want to file a handsaw, use your miter box. Just insert the saw blade in the box as indicated, using small wedge pieces if the saw is too loose. The box permits locating the saw at the most convenient angle for filing.

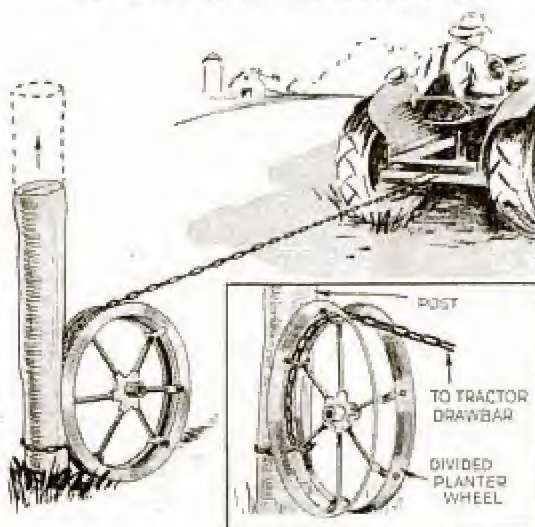


Stamp Pad Prints Gasket Patterns



When you have duplicate gaskets to cut from thin material, you can mark the patterns rapidly by using a rubber stamp pad over the pattern or sample. The pad should be fully moistened to make clear outlines.

Pulling Fence Posts Done Easily With Wheel and Tractor

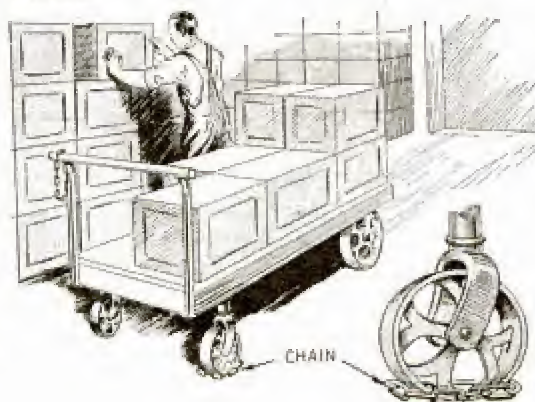


The tedious job of pulling wooden fence posts was simplified by one farmer who uses his tractor for the work. A divided corn-planter wheel is placed against the post as shown, after which a chain is hooked around the post near the ground and run over the wheel to the tractor draw bar. Use of the divided wheel prevents the chain from slipping to one side, thus giving a continuous pull on the post.

—W. C. Lammey, Sandwich, Ill.

Chain Provides Two-Way Chock For Platform Truck

Carried on the handle of a platform truck, a short length of heavy chain serves as a handy two-way wheel chock to keep the truck from rolling down an incline while it is being loaded. One end of the chain is fitted with a hook so that the ends can be locked together, making it impossible for the chock to work away from the wheel.



How to Sharpen MILLING CUTTERS



Photos courtesy Brown and Sharpe Co.

By H. J. Chamberland

MILLING cutters can be kept in long service if sharpened before they become excessively dull, otherwise so much metal must be removed that the life of the cutter is shortened proportionately. Also, by constantly keeping the cutters in good condition, accuracy and quality in the results obtained will be uniform.

Special grinding machines: For grinding the cutters there are special machines such as the one shown at the upper right corner of the opposite page and in Fig. 2. As a modern precision grinding machine is well balanced, rigid, has ease of operation with universal adjustments, its use is preferable to the use of a lathe and grinding attachments. Although exact details of grinders made by different manufacturers may vary, they are basically similar in general arrangement and operation.

Clearance angles on cutters: On most milling cutters, except formed cutters, the "land" or narrow, flat portion just behind the cutting edge of each tooth, as illustrat-

ed in Fig. 8, must be ground down to retain the edge. The land slopes downward from the edge to provide clearance and this clearance angle varies from 4 to 7 degrees for peripheral teeth, (teeth on the circumference of a cutter), and 2 or 3 degrees for side teeth. The width of lands varies with different cutters; for mills less than 3 in. in diameter, $\frac{1}{16}$ in. is ample and, on mills over 6 in. in diameter, $\frac{3}{16}$ in. lands are permissible. When grinding down the lands they become wider, necessitating removal of metal from the rear of the land at a secondary clearance angle as shown in Fig. 8.

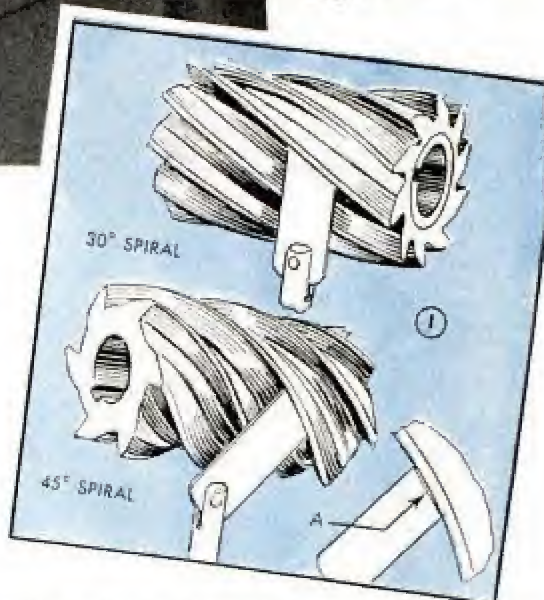
Grinding wheels commonly used: Either a cup or a straight disk wheel may be used for grinding ordinary milling cutters. A cup wheel grinds flat lands but a disk wheel grinds a slightly concave land, which causes the cutter to dull more quickly. With this in view, it is best not to use a disk wheel smaller than 5 in. in diameter. As the land generally does not exceed $\frac{1}{16}$ in., the slight amount of concavity pro-



Extreme accuracy in keeping the mills sharp, which is done on precision grinding machines such as this one, makes possible today's uniformity of results in quantity production

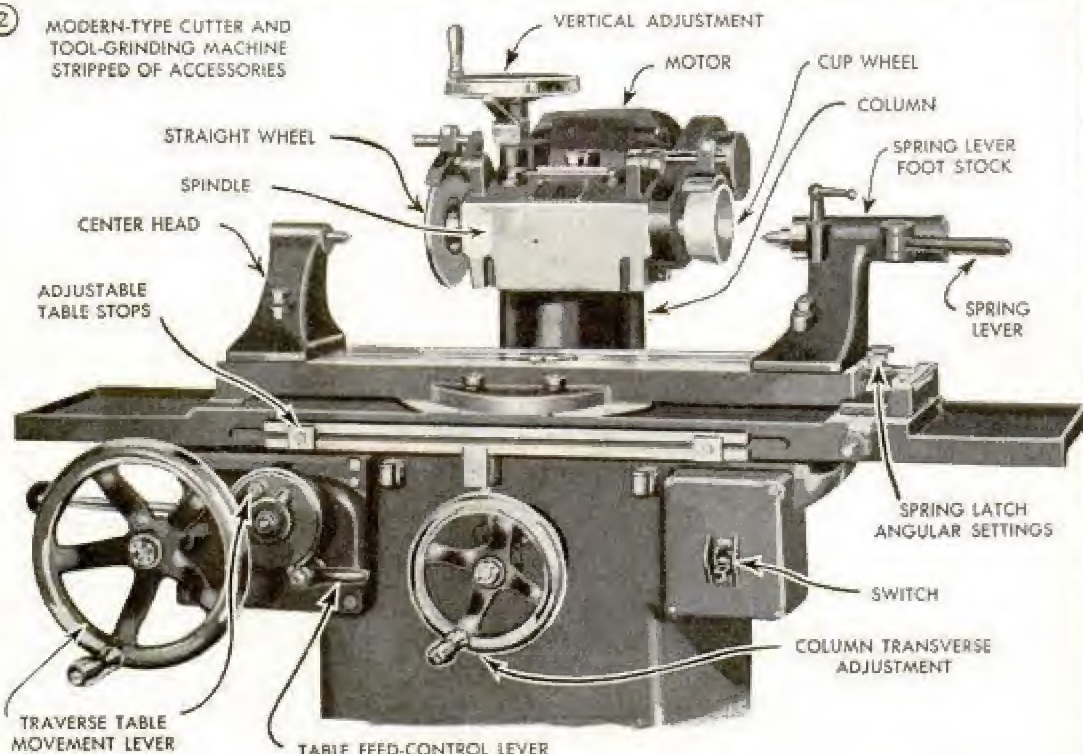
duced by a 5 or 6-in. wheel is not objectionable. A cup wheel should always be used to clear end teeth of end mills, and given preference for grinding teeth of side mills, although, as shown in Fig. 5, a disk wheel may be used for the latter operation.

The tooth rest: When grinding a tooth, it should bear against a tooth rest, also called a finger rest, which is set to conform to the spiral angle of the teeth as shown in Fig. 1, so that the portion being ground always will be at the correct angle. In the grinding operation shown in Fig. 5, the grinding wheel cuts from the front toward the back of the tooth, in which case the operator must be extremely careful to hold the face of the tooth against the rest constantly, or the wheel will pull the cutter in its direction of rotation. Naturally, this should not be attempted by a beginner. For a 30-degree tooth spiral, the rest may be adjusted vertically, but for a 45-degree angle, it is tilted to avoid grinding off the top at an impractical angle. The edge of the rest must be ground slightly convex to bear against the tooth snugly—not to touch at the corners only as in detail A.

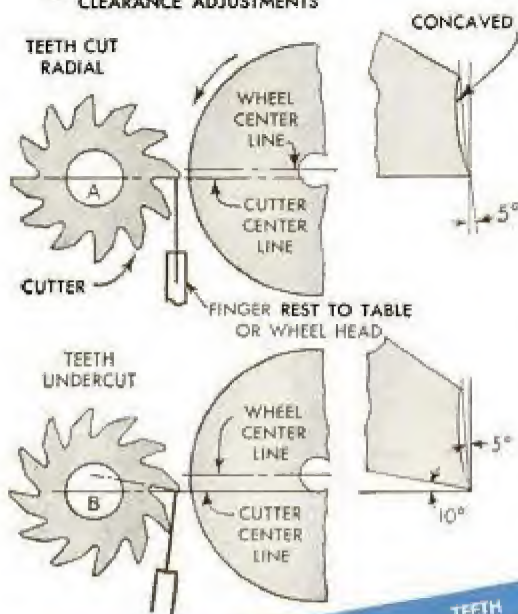


Relation of center lines when grinding: When using a straight wheel to sharpen a cutter with radial teeth, (face of teeth coinciding with line from center of cutter to cutting edge), whether the cutter is straight or spirally fluted, the tooth rest is adjusted so that the face of a tooth is horizontal as in Fig. 3-A. The amount of clearance angle of the land is determined by how much the center line of the grinding wheel is above the center line of the cutter. On mills that have undercut teeth, (face of teeth cut at an angle to the radial line as in Fig. 3-B,,

② MODERN-TYPE CUTTER AND TOOL-GRINDING MACHINE STRIPPED OF ACCESSORIES

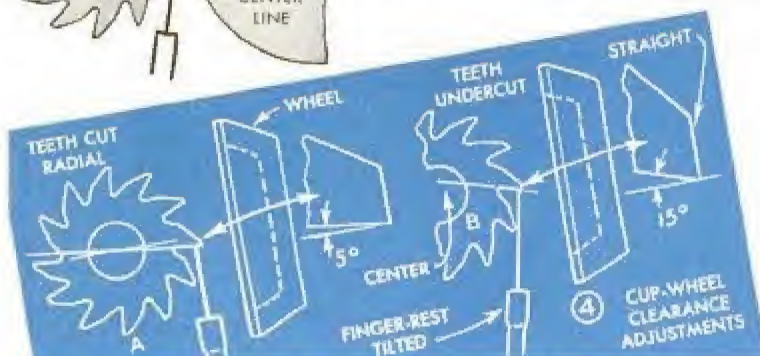


③ STRAIGHT-WHEEL CLEARANCE ADJUSTMENTS



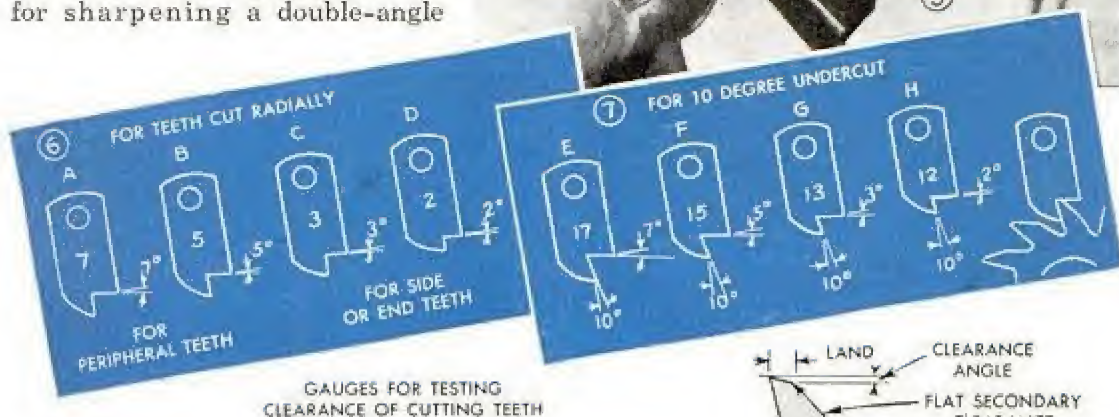
the tooth rest is adjusted so that the edge of the cutter is on the radial line, the center line of the cutter being below the center line of the wheel. When using a cup wheel, the relation of the center lines of wheel and cutter is immaterial as the grinding is done on the side of the wheel. When a cup wheel is used to grind a cutter with radial teeth, the tooth rest is adjusted so that the face of each tooth is inclined at an angle equal to the amount of clearance angle desired. This set-up is shown in Fig. 4-A. When grinding is done on teeth that are undercut as shown in Fig. 4-B, the angle at which the face of the teeth is inclined must be increased to compensate for the undercut, and the tooth rest must be tilted at an angle as indicated.

Computing tooth angles: Fig. 9 shows enlarged views of radial and undercut peripheral teeth. Line B in the upper detail is on the center line of the cutter. The angle included by lines A and B is 90 degrees and the clearance angle between lines A and C is 5 degrees. In the lower de-



tail, the tooth has a 10-degree undercut between the center line and line B, producing an 80-degree angle between lines A and B. For checking these angles, a set of gauges as shown in Figs. 6 and 7 will be found convenient. They may be made of $\frac{1}{16}$ -in. stock, case-hardened and kept on a key ring.

Sharpening set-ups: Generally cutters are sharpened by mounting them on gang or stud arbors. The conventional procedure is to use a tube-style arbor to mount the cutter, after which the assembly is traversed on a bar either fitted between centers or clamped to a work head as shown in Fig. 10. This photo shows sharpening the peripheral teeth of a staggered cut side mill. Fig. 13 shows a set-up for sharpening a double-angle

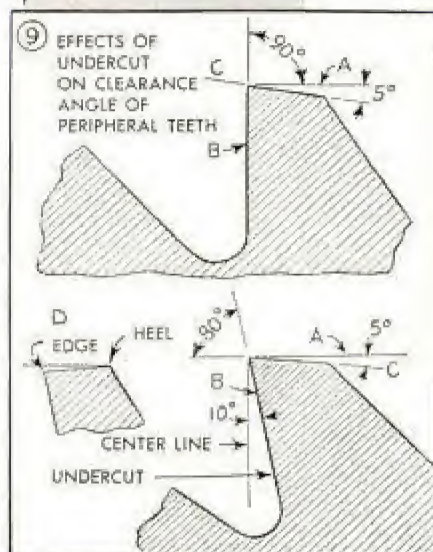
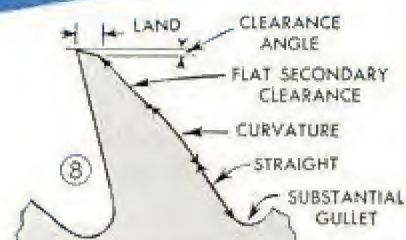


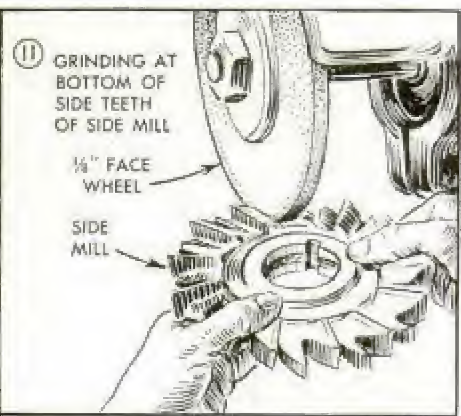
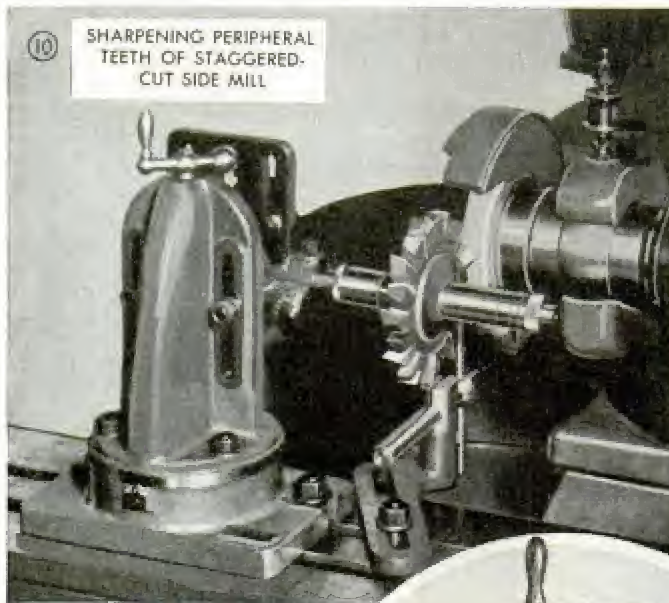
GAUGES FOR TESTING CLEARANCE OF CUTTING TEETH

cutter. Such cutters are sharpened like straight-fluted mills. After successive sharpenings of side teeth, side mills lack clearance at the point indicated in Fig. 12. To remedy this, use a narrow grinding wheel to increase the depth of the spacing between teeth as shown in Fig. 11.

Test for cracked grinding wheel: A grinding wheel should never be left on a bench or machine table. If you find any grinding wheel out of its proper place, pass a bar through the hole and tap it gently with a file or screw driver as shown in Fig. 15. If the sound has no ringlike continuance, the wheel may be cracked and should not be used.

Dressing the wheel: The results of dressing the face or side of a grinding wheel with an abrasive stick are quite different from the results obtained by using a diamond dressing tool. Both ways are shown in Fig. 14. When grinding down a cutter tooth about .005 in. with a wheel dressed by means of an abrasive stick or stone, the surface of the cutter edge will appear as shown in Fig. 18-A, if magnified about 100 times. The "hills" will soon crum-

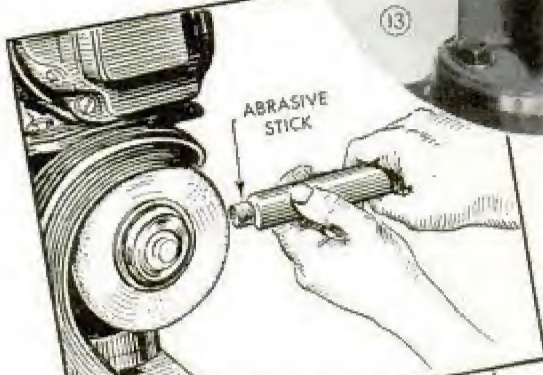
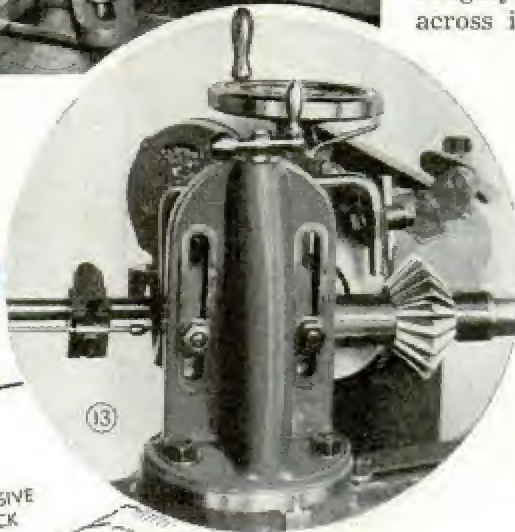




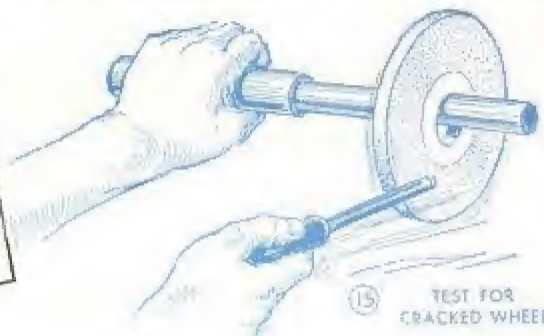
ble and the tool will be dulled quickly. If the wheel, dressed roughly with a few rapid passes across its face with a diamond dresser, is used to grind down a milling cutter .005 in., the magnified cutter edge will resemble the view shown in Fig. 18-B. If, after this, the grinding wheel is faced by taking a few slow passes with the diamond dresser, and then grinding the cutter tooth only .002 or .003 in., the improved surface, when magnified, will look like Fig. 18-C. Then

it only remains to impart the final superfinishing touch.

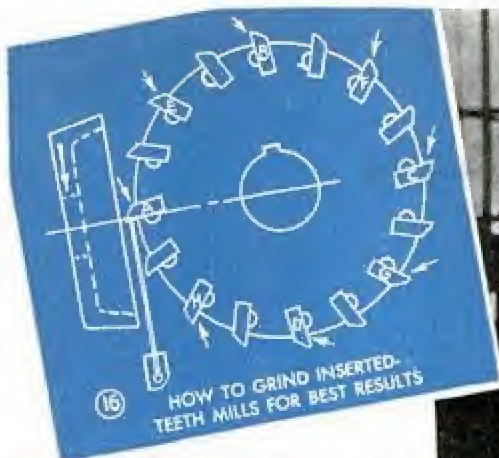
Grades of wheels to use: For the primary and secondary grinds, "white" wheels are preferred by many. Using the symbol of a well known manufacturer, a 3860-K5BE is the correct wheel to use for this purpose, it being run at a speed of 5,000 to 5,500 surface feet per minute, (s.f.p.m.). For the superfinishing operation, a 37320-J8L



14 OLD AND NEW WAYS TO DRESS WHEEL



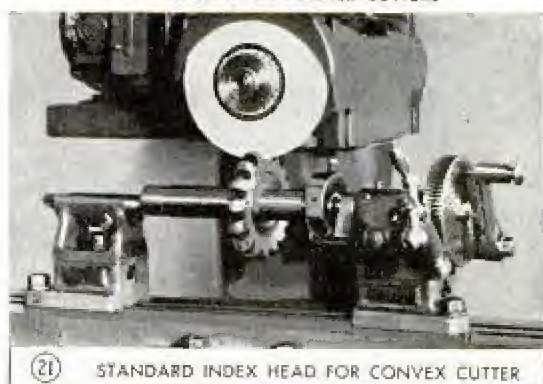
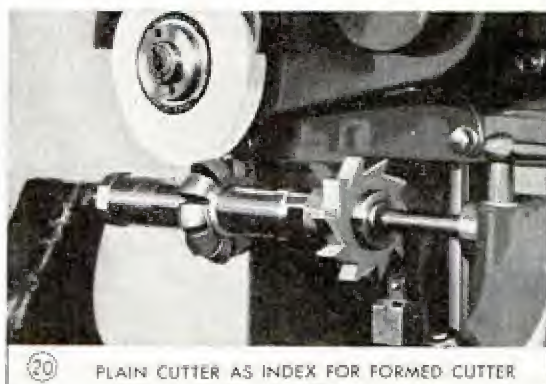
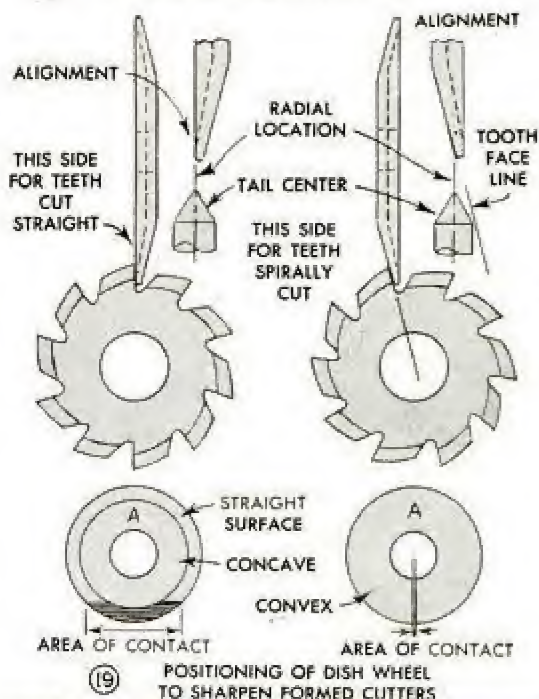
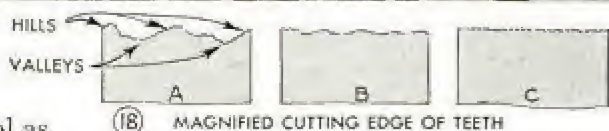
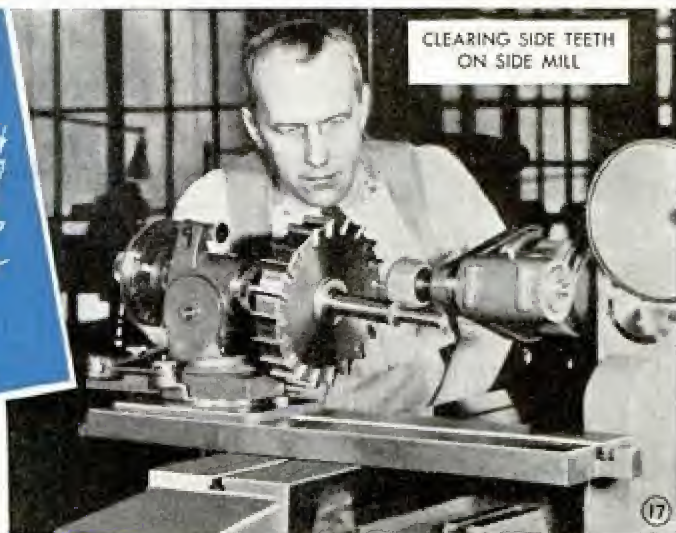
15 TEST FOR CRACKED WHEEL

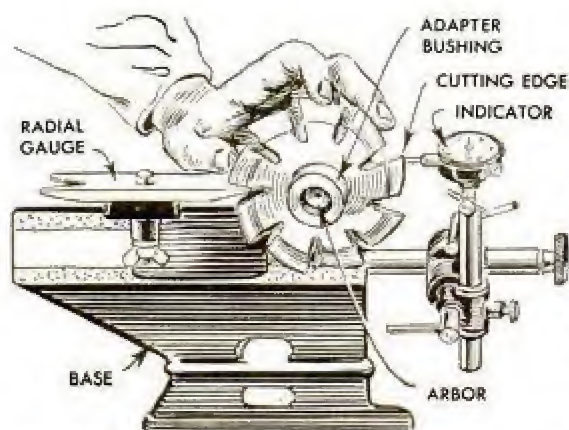


wheel is substituted and the speed should be reduced to approximately 1,000 s.f.p.m. This wheel does in a few minutes what would require an hour's time by hand stoning. It seldom requires dressing with the diamond tool as it is intended to remove only .001 to .0015 in. of metal to produce the desired finish.

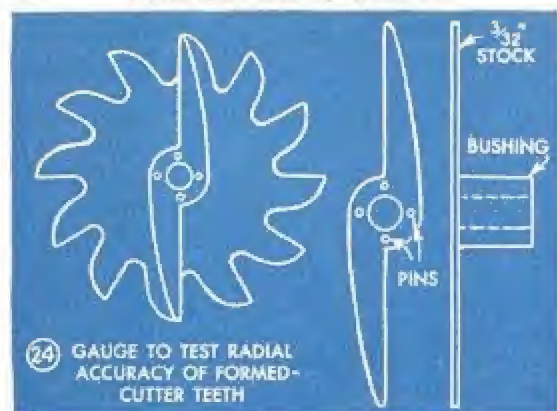
Sharpening mill with inserted teeth: Fig. 17 shows a 12-in. inserted-teeth mill being superfinished on the side teeth. To avoid errors of runout, the procedure described in Fig. 16 is quite dependable. The cross-feed is adjusted to remove from .003 to .005 in. of stock, clearing teeth A, B, C and D. Then tooth A is returned to the grinding wheel and every tooth is cleared in succession. Difference in sparking shows whether or not the teeth are equidistant or alike radially. For the second cut, the cycle is repeated with teeth E, F, G and H, but only half as much stock is removed from the teeth.

Formed cutters: In sharpening formed cutters there is no clearance angle to consider. The secret is to preserve the original tooth face and the spacing between the teeth so they will cut alike. Formed

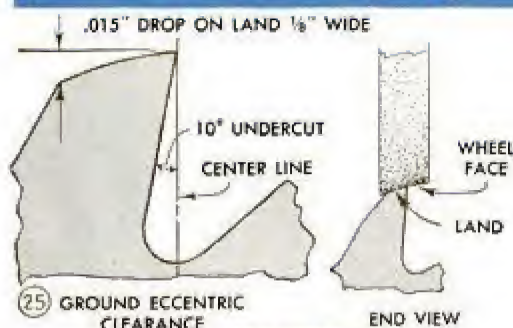




(22) TESTING FORMED CUTTERS FOR EQUIDISTANCE AND RADIAL ACCURACY OF TEETH

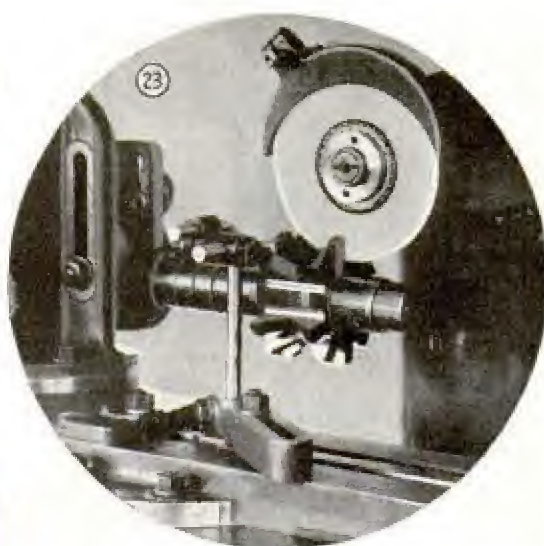
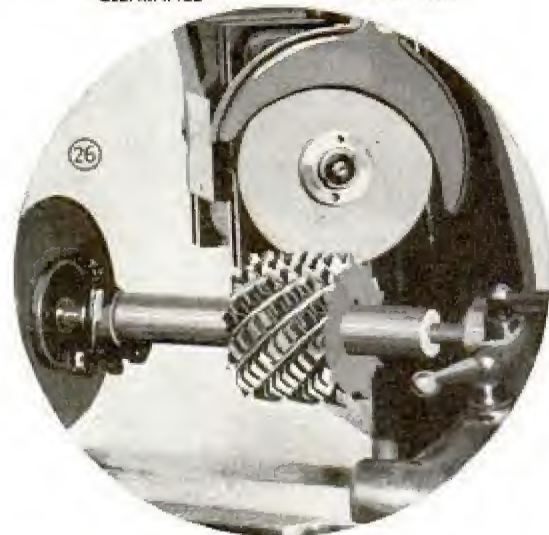


(24) GAUGE TO TEST RADIAL ACCURACY OF FORMED-CUTTER TEETH



(25) GROUND ECCENTRIC CLEARANCE

END VIEW



cutters with radially cut teeth will not duplicate their form on work if the radial face is altered.

A dish or saucer-shaped grinding wheel is used to sharpen formed cutters. As shown in Fig. 19, the straight edge of the concave side is used for straight-fluted mills, and the angular or convex side for spirally fluted mills. The area of wheel contact when grinding straight-fluted mills, is shown in the lower left detail A of Fig. 19. When sharpening spiral teeth, the area of wheel contact is limited to its radial line as in the lower right-hand detail A, otherwise the curvature of the spiral could not be duplicated.

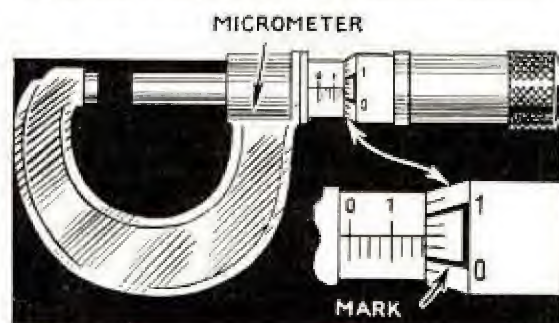
There are several set-ups to sharpen formed cutters so that the flutes may be spaced accurately, speaking of straight-cut mills exclusively. A set-up frequently used is to mount on the arbor with the formed cutters, a plain cutter having the same number of divisions, so it can serve as an indexing head as in Fig. 20. The first step, regardless of set-up, is to align the tail center with the straight side of the wheel as in Fig. 19. The crossfeed must not be disturbed as the radial line is established already. With the nut loose on the arbor, the face of the first tooth to be sharpened is positioned against the cutting side of the wheel and then the nut is tightened securely. The face of the tooth of the plain cutter must contact the rest when the tooth to be ground is positioned correctly. The amount of stock to be removed is regulated by raising the rest slightly, which will not affect radial adjustment. In Fig. 21 a similar but larger cutter is be-

ing sharpened but in this case a standard indexing head is used. Fig. 22 shows a fixture commonly used to test equidistance of cutting edges. While the cutter shown is of the gear type, the fixture serves for any kind or width of cutter by using the proper adapter bushing. A radial gauge is also provided.

In shops where formed cutters are used sparingly, the radial gauge shown in Fig. 24 is handy. The periphery should be checked with a dial indicator. For the sharpening operation shown in Fig. 23, the tooth rest indexes from the back of the teeth. This procedure is quite practical as this surface is never ground. Fig. 25 gives an idea as to what is meant by a ground eccentric clearance. The set-up to sharpen teeth of a plain cutter this way is identical to that for sharpening teeth of formed cutters. Instead of grinding the face, the clearance angle on the teeth is produced by forming the face of the grinding wheel. Sharpening spiral hobs, Fig. 26, demands special provisions. Faces of spiral teeth are sharpened as flutes are milled. The grinding wheel is set at the angle of the spiral as shown in the right detail of Fig. 19. The face of each tooth is aligned with the convex side of wheel, after locating radially.

Next month: Die Making

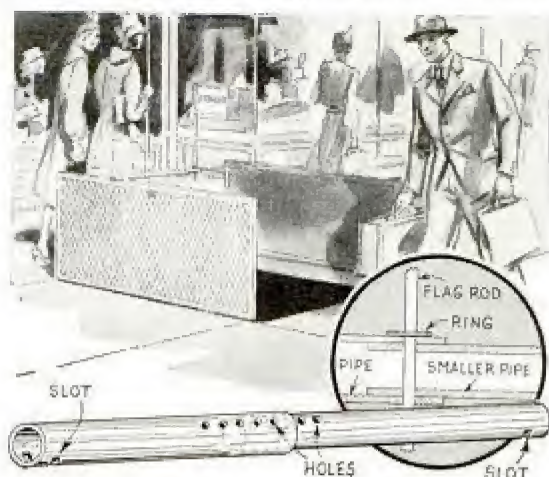
Bracket on Micrometer Reading Speeds Duplicate Measurements



When a number of pieces having the same dimensions and tolerances are to be checked with a micrometer, considerable time can be saved and eye strain avoided by marking the high and low permissible readings on the micrometer. When these two marks are connected by a line to form a bracket, a glance will enable the operator to tell instantly whether or not the measurement comes within the specified limits.

—Bob Hewitt, West Hartford, Conn.

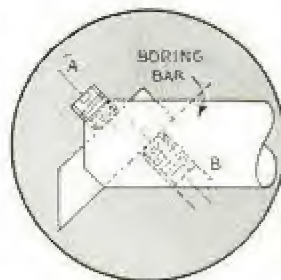
Trap Door to Basement Entrance Kept Open by Adjustable Holder



When trap doors in the sidewalk in front of his store must be opened to enter the basement, one merchant uses an adjustable holder to keep them in a vertical position and, at the same time, support a red warning flag. The flag and the position of the doors serve as a double warning to prevent anyone from accidentally walking into the opening. The holder is made from two lengths of pipe, one small enough to telescope inside the other. Several holes are drilled through both pipes, and a length of iron rod is inserted through the holes to lock the adjustment of the holder, thus preventing the pipes from being pulled apart or forced together while spanning the doors. The iron rod also serves as a support for the flag.

Where to Locate the Set Screw In a Homemade Boring Bar

Machinists who make their own boring bars of round or square stock often experience trouble at point A because there is insufficient metal to allow proper tightening of the set screw without stripping the threads. Locating the screw at point B not only gives the tool longer life, but also allows entry into smaller openings in the work because the screw does not project beyond the body of the bar.



Straw Cushion Slips Over Seat Of Farm Implement



A comfortable cushion, which will remain in place on a farm-implement seat with little or no attention, can be made by filling a burlap sack half full of hay or straw. When the hay is in place, sew across

the middle of the sack to hold the filling. Then, turn the remaining portion of the sack inside out to draw the cushion portion inside it. The pocket thus formed is slipped over the implement seat, with the cushion part on top.

Holder to Place Flat Washers Centrally Over Holes

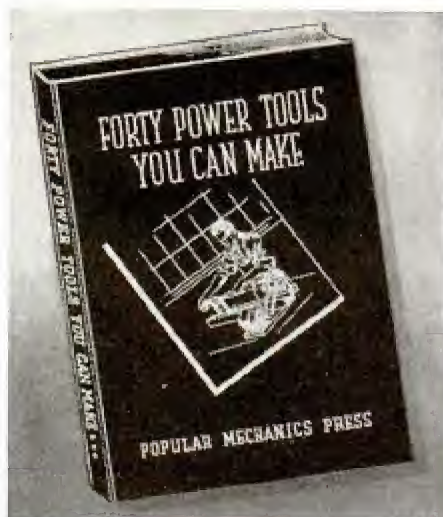
When placing washers exactly over a drilled or tapped hole, this holder will be found useful. It can be made by bending a nail or small rod as indicated depending on the size of washer. In use, the washers are slipped onto the holder and then the point is placed directly into the hole and one or several washers fed off as required. The holder will be found especially useful on production lines and other places where quick placing of the washers is essential.

—Allen Fiske, Chicago.



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Do you want a motorized workshop that is inexpensive, will speed up your work and do it accurately? Then don't fail to get this amazing book! It shows every detail and explains in non-technical style just how to go about making forty different machines. The material used to build them is available almost anywhere—standard iron and brass stock, wood, pipe, old auto parts, etc., which can be picked up for almost nothing. If you want to earn extra money by making things in your spare time to sell, you'll need to employ fast production methods only possible with motorized equipment. Building just one of the tools described in this book will pay for it many times. Send for your copy now and start making the machine you want.



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| Midget Circular Saw | Hand Belt Sander |
| Sliding Cut-off Saw | Small Shaper |
| Scroll Saw | Heavy Duty Grinder |
| Band Saw | Small Portable Grinder |
| Drill Press | Metal-turning Lathe |
| Wood-turning Lathe | Hack Saw |
| Disk Sander | Filing Machine |
| Belt Sander | Milling Unit |
| Drum Sander | Abrasive Cut-off Wheel |

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Radio

First Aid for Receivers

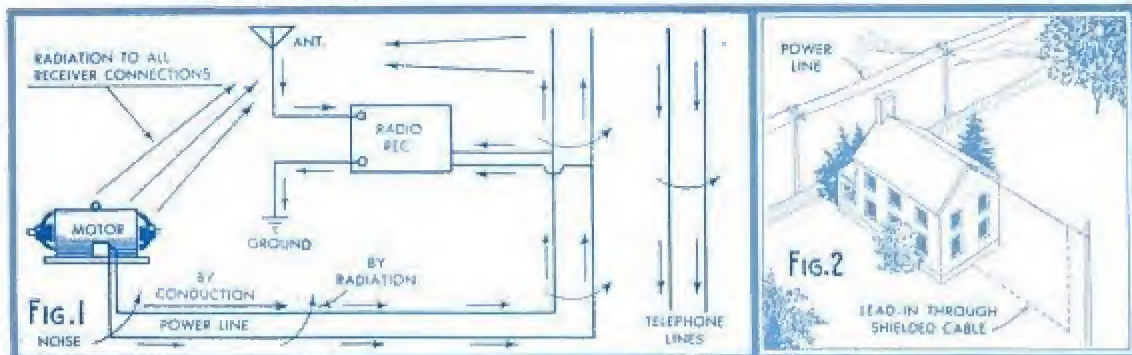
PART VIII

TWO devices which are responsible for a large portion of radio noise conditions are automatic switching circuits and commutator-type motors. In operation, these create intermittent sparking as a result of rapid change of electrical conditions. This sudden change in current causes the motor to act like a small transmitting station, sending out waves which find their way into receivers as illustrated in Fig. 1, unless suitable filters are employed.

A simple remedy for eliminating a great deal of interference from a nearby power line is to run the antenna at right angles to such a line as shown in Fig. 2. In difficult cases connect the lead-in wire at the far end and bring it into the house through a buried shielded cable. Conducted energy passing through the power line may be picked up over a considerable distance, direct radiation however does not extend far from the source of the interference.

The location of the receiver in the home is often an important factor, and most set owners have found reception in some rooms freer from background noise than in others. If you have a console set do not push it directly up against the wall as illustrated in sketch Fig. A. For best tone quality keep it out at least 6 in. from the wall, or place it across a corner of the room as shown in photo B.

(To be continued)



GRILLE CLOTH

SPEAKER

VOLUME CONTROL

SWITCH

SHIELD THIS SET-UP

TAPING JACK

TRANS

SFR. TRANS

SFR. TRANS. CHROME

SFR. PLUG

An easy project for radio students, the a.c.-d.c. circuit eliminates the need for a power transformer. It uses 4 standard tubes: one 6C5-GT, for the first audio, two 25L6-GT's as power amplifiers, and a 25Z6-GT rectifier. All of the parts are standard values, most of which may be found in a well-stocked "junk box." Only a few common hand tools are necessary to build the unit as it employs an easily worked hard pressed wood base. This base is mounted on a wood frame which also serves to support the 1½-in. soft pressed wood baffle to which the speaker is bolted.

FIG. 1

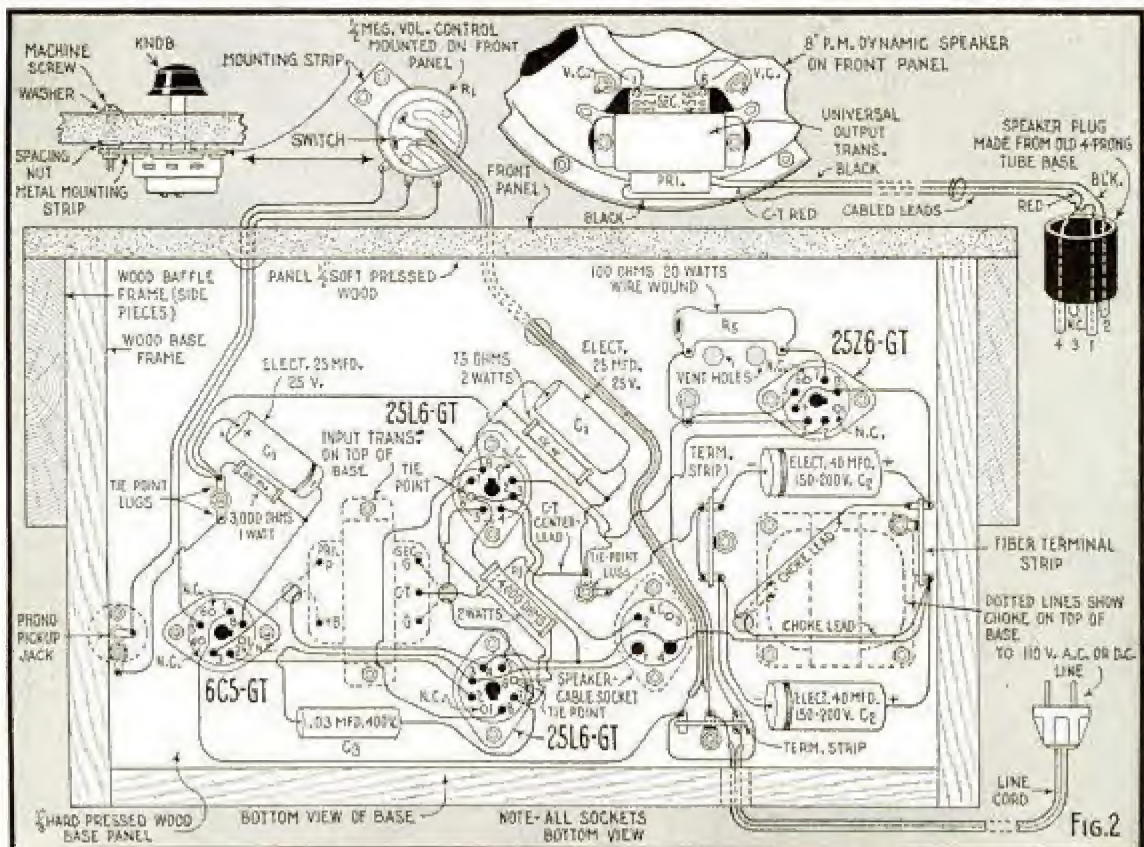
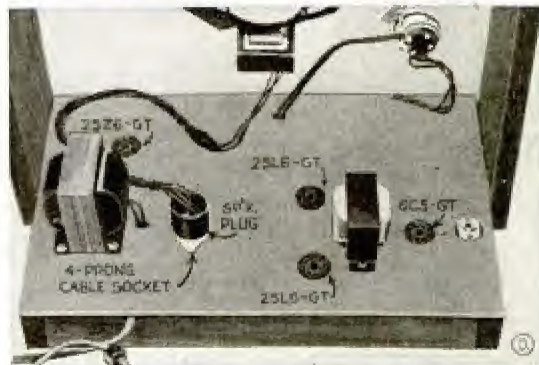


A.C.D.C. PHONO AMPLIFIER

of the parts under the base. No. 18 or 20 push-back hook-up wire is easiest to use, although "bell wire" will do very nicely and is available in many "ten to a dollar" stores. Be particularly careful in wiring the sockets, the easiest place to make a mistake. Note that the "dead" No. 6 prongs on the sockets serve as tie points for some of the fixed resistors and condensers.

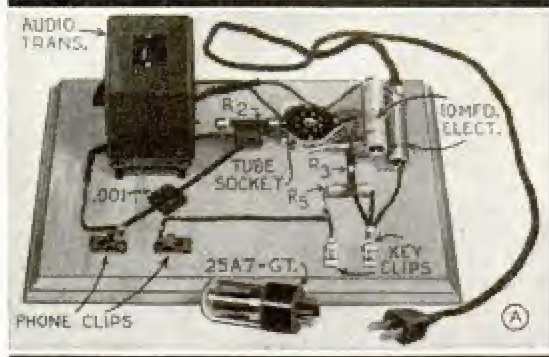
The universal output transformer is mounted directly on the speaker, the primary leads being cabled to the plug. With most output transformers of this type the taps to provide the proper load for two 25L6-GT tubes will be 1 and 6. When completed, plug in the tubes and speaker and test the unit. As soon as the tubes warm up you should hear a slight hum in the speaker. Now plug in the cable

(Continued to page 172)



Safety Code Oscillator for Radio Students

By L. M. Dezettel, W9SFW

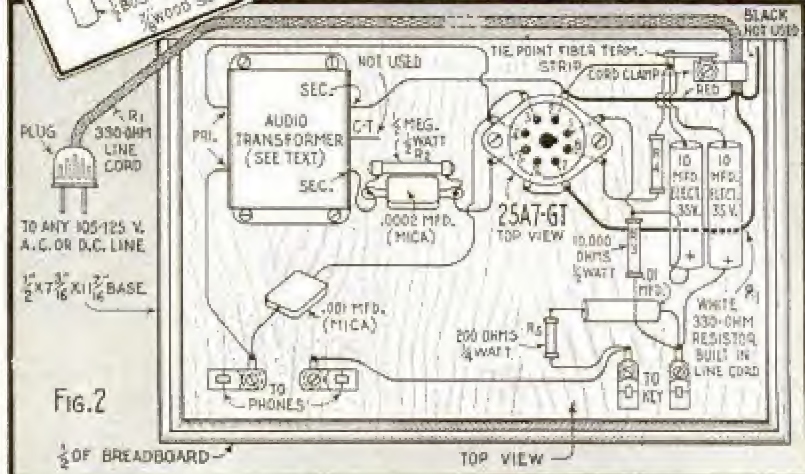
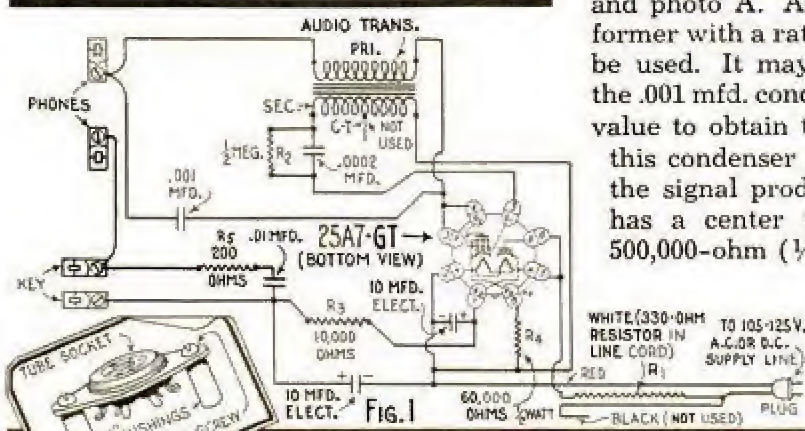


HERE is a code-practice oscillator that produces a pure tone and is safe to operate. The tone generated is a true sine-wave of about 1,200 cycles with no harmonics. The builder will note that the tone closely resembles the actual signal heard from a receiver, which is a decided improvement over ordinary code-practice oscillators that quickly tire the student. Anyone can build and operate this simple unit that works from any standard 105 to 125 volt a.c. or d.c. house lighting circuit.

Designed so that the actual working voltage is only 25 volts, the same safe low value applied to the heater of the 25A7-GT tube is also rectified and filtered and then used for the "B" supply to the pentode portion of the tube. Junk box parts may be used as the values specified are not critical.

The oscillations are produced by feedback between windings of the audio transformer shown in diagrams Figs. 1 and 2, and photo A. Any interstage type transformer with a ratio of 1 to 1 or 1 to 3½ may be used. It may be necessary to change the .001 mfd. condenser to a higher or lower value to obtain the most suitable tone, as this condenser controls the frequency of the signal produced. If the transformer has a center tap, just ignore it. The 500,000-ohm (½ megohm) grid leak may be any value from 250,000 ohms to 1 megohm. Paper type condensers may be sub-

(Continued to page 174)



LETTERS	
A	N
B	O
C	P
D	Q
E	R
F	S
G	T
H	U
I	V
J	W
K	X
L	Y
M	Z
NUMBERS	
1	6
2	7
3	8
4	9
5	0
PUNCTUATION	
PERIOD	
COMMA	
QUESTION MARK	
THE CONTINENTAL CODE	

Helpful RADIO SUGGESTIONS

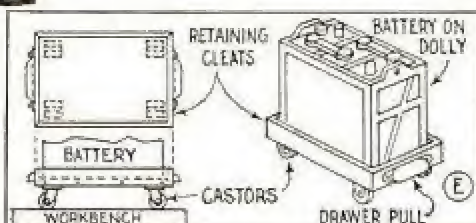
(A) Blanks for home recording cut from old X-ray negatives provide an economical way to experiment with audio amplifier sound effects, and for making practice recordings that you want letter perfect before you put them on commercial blanks. See your family doctor for a supply of discarded negatives; remove the film and use an old blank for a pattern. Center the spindle hole, and locate the locking-pin hole, on a small wooden template. A pair of dividers, a razor blade and a small hand drill are necessary tools. Use common wood bits for the holes and reverse to cut clean. Recordings may be made on both sides; use an old blank under the negative for proper cutting needle height.



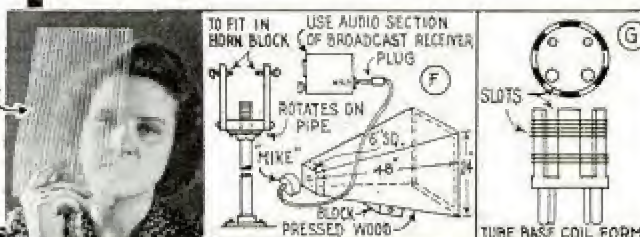
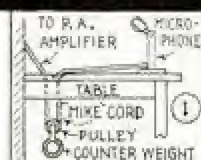
(B) Handy test light for illuminating hard-to-reach screws in dark corners operates on regular line voltage; a transparent plastic cover protects the bulb from breakage.



(C) Battery plugs fit plug-in dry A and B-batteries; make convenient connectors for student sets. (D) Plastic speaker grill covering replaces metal cloth



(E) Homemade storage-battery dolly for the workbench is a time and labor saver. (F) Experimental plane locator for citizen listening post employs a weatherproofed pressed wood horn on a wood frame and an adjustable mounting. (G) Slots sawed in tube-base coil form help reduce losses on high frequency bands, Duco cement holds turns in place. (H) Mounting for panel light has transparent molded cap. (I) Handy take-up reel for "mike" cord. (J) Recharging 6-volt battery on 12 or 32-volt d.c. farm supply



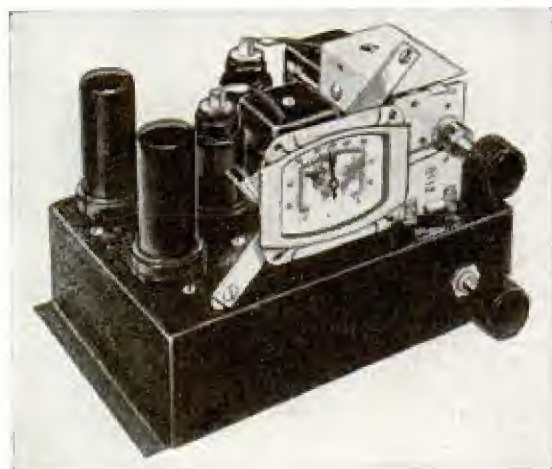
High Standards for S-W Receivers



So close are the tolerances to which manufacturers of "wartime" communications type receivers work that instruments worth many thousands of dollars are needed in making the final tests to insure that each receiver produced is up to the high standards established for it in the design laboratory. The photo shows one of several such final-test positions.

4-Tube A.C.-D.C. Training Kit

Designed for defense radio training, this 4-tube t.r.f. receiver is available in a kit



that contains all parts except the tubes and speaker. Compact high-gain shielded coils are tuned with a 2-gang condenser, and the frequency range is from 530 to 1600 kilocycles. Provision is made for mounting a 5-in. dynamic speaker. Diagrams are supplied by the manufacturer who claims that the set has good sensitivity and pleasing tone quality.

"Acoustic" Sound-Level Meter

Opening fields that high cost and lack of portability have closed to former equipment, this compact instrument covers all usual sound measurements. Some of these applications are measurements of noise produced by electric refrigerators, trans-



former hum, comparison of radio and public address speaker efficiencies and noise surveys in offices and public buildings. A crystal microphone of the nondirectional "ball" type is employed; the output of this microphone passes through a battery-operated amplifier to the indicating meter.

Blueprints covering simplified radio construction articles in this and past issues are available for 25c each. Many popular tested circuits for beginners, students and experimenters may be built with used parts. Detailed material lists can be obtained from Popular Mechanics Radio Department upon receipt of postage.

NEXT MONTH—Two Modern Crystal Sets for Beginners. Designed to meet a demand for low-cost, efficient receivers for students; one is a straight crystal set and the other employs a crystal detector with a tube as an audio amplifier. Also—**Radio Set Serves as Automatic Fire Alarm; and First Aid for Receivers, Part 9.**

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now fight the Axis

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for 20 mm. and 37
mm. Shells. Saves
Time, Reduces Waste.**



● On rotating bands for 20 mm. shells, the Delta Cut-Off Machine using a 8" dia. steel blade, .045 thick, 144 teeth, raised output from 20 pieces a minute to 50 per minute and the burring operation was entirely eliminated. All rings were held to required tolerances. A simple clamp and special feed mechanism furnished by the user were employed. On the rotating bands for 37 mm. shells, output was increased from 10 pieces per minute to 25 pieces per minute! In all instances waste was reduced 50%!

Previously this job had been handled on screw machines. Think what this means: A Delta Cut-Off Machine costing approximately \$250 on these jobs produces twice as fast as a \$6000 screw machine, eliminates burring operation, reduces waste and releases the screw machine for work it can handle more efficiently.

TO ALL HOME CRAFTSMEN:

100% of the present output of Delta machines goes into the war program. Thus the machine we cannot sell you is helping build the armaments needed to win the war. During this period, Delta engineering and research continue apace. When the war is over, and home workshop chips resume flying, you are assured more Delta machine value than ever!

In the meantime, keep in touch with latest developments in the crafts field by subscribing to the Delta-gram. This unique craftsman's magazine is published 6 times a year—during the months that every home workshop owner can best use it. It is crowded with exclusive new and different plans and ideas—plus hundreds of helpful, practical shop suggestions. Mail the coupon today!

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Argus is proud of having a part in building these amazing fire-control instruments that direct gunfire with such deadly accuracy to the target.

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Hex	$\frac{3}{8}$ "	$\frac{3}{8}$ "	$\frac{3}{8}$ "
Thread	$\frac{3}{8}$ "-24	$\frac{1}{4}$ "-32	$\frac{1}{4}$ "-32
Thread Length	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{5}{32}$
Weight, Grams	8	$3\frac{1}{2}$	$2\frac{1}{2}$

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Silliment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

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GOOD NEWS!

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SYNCRU SAW Owners!**

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SYNCRU WORLD SAFETY SAWS

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Maps for the Air Age

(Continued from page 32)

Maine coast and the stratosphere highway passes over Iceland and the lower tip of Greenland.

Tokyo is 8,423 miles from the Panama Canal via the great circle route which passes over Dutch Harbor, Salt Lake City and Houston. The shortest way from Oklahoma City to Ceylon is almost directly over the North Pole—9,500 miles.

Air distances are converted quickly to flying hours which are reduced by every advancement of aviation. Some distances that loom significant in the air-age world are: New York to Chungking, 7,500 miles; Fairbanks, Alaska, to Berlin, 4,300 miles; San Francisco to Sydney, Australia, via Honolulu, 7,548 miles, and Duluth to the coast of Norway, 3,750 miles.

A new globe that is helping correct the general east-west misconception of distances from the United States—"Europe is straight east; Asia is straight west"—has what is called a universal mount. The ball turns freely in a cradle. A vertical ring over the top holds it in place and hinged blades on either side are used to measure great circle routes. By placing the United States at the zero point on the blade, one can see quickly that Europe is more nearly north than east and that Asia lies to the north instead of to the west.

Map companies today are doing their largest volume of business in history. A leading company estimated its total output this year "in the neighborhood of 100,000,000 maps." Never before have persons been so interested in the entire world. The maps that are found in almost every edition of newspapers testify to the demands of the public.

Where is Palembang? Unalaska? Port Moresby? Petropavlovsk? The chances are that you know or have a pretty good idea. How far is it from Hawaii to the Marshall Islands? From Dutch Harbor to Tokyo? From Vladivostok to Yokohama? From Dakar to Panama? These are vital questions and a war-conscious America is busy getting the answers.

The importance of maps in enabling a person to grasp the scope of global war was stressed by President Roosevelt when he asked the nation to look at "a map of the

POPULAR MECHANICS

whole earth" while he gave a radio address.

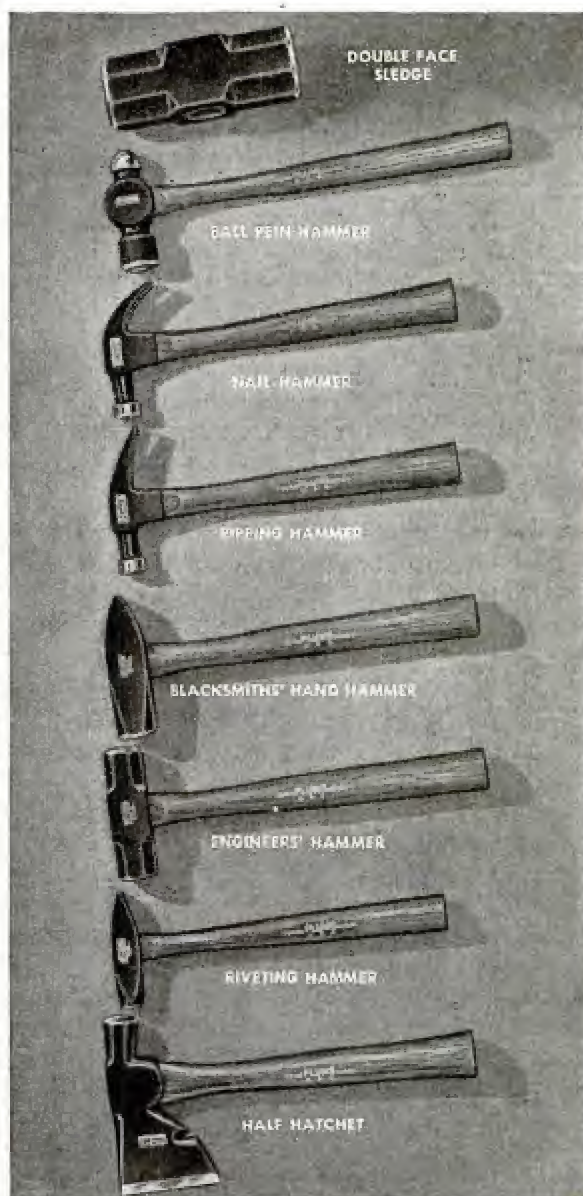
Not only on the home front are maps helping fight the war, but in the wardrooms of warships, staff headquarters behind the lines, in cabins of giant bombers and in the training stations and camps for the army, navy and marines. The spectacular commandos are drilled in map reading until they can tell at a glance the topography of a coastal area where an attack is planned.

Making maps from aerial photographs, now developed to a high degree by the army, did not become widespread until after World War I. It took years of experiment before accurate maps were made by air survey methods. The American Geographical Society spent six years mapping northern Labrador from 600 aerial photographs and designing special instruments for the work. Now the army completes a sketch from an aerial photograph in the field and rushes it to troops moving to a new position on the battlefield.

Meanwhile, the "mills" of the map-makers are grinding out maps for peace as well as war, commercial maps to further the interests of hundreds of industries. These maps, based on careful research, outline trading areas, concentrations of population, divisions formed by highways and railroads, rich agricultural districts, the location of mineral deposits, oil wells, and contain other important information. A unique map, prepared by Dr. John M. Wigmore of Northwestern University, traces the world's legal systems. Maps, always colorful, are also made for decorative purposes and have been used to cover the entire walls, ceilings and floors of rooms.

More road maps are made than any other type. Last year more than 120,000,000 road maps were printed, mostly for large oil companies and state highway departments. Sometimes a single road map is changed four times in one year, necessitated by new highways and the improvement or deterioration of old ones.

Maps of all types are undergoing constant change—a change that has been continuous since the first primitive man scratched the outline of river, hill and tree on a piece of bark. Each change is dictated by man's conception of the earth. None has been more revolutionary than the map for the air age—the map that points the way to American leadership in the postwar world.



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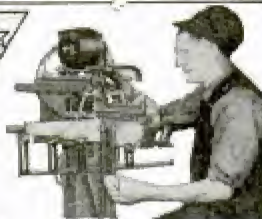
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Keeping Our Underground Rivers Flowing

(Continued from page 95)

drains, flushing is done when necessary with fire fighting equipment. Walls are carefully washed down to keep them clean and moist. Silt is either carried away by the flow or loaded on little trucks, known to maintenance crews as "creeps." These creeps are also used for inspection tours in dry mains—the inspector riding on one knee while he pumps with the other foot.

The inspection of conduits is also quite a job. It is as dark as a whale's stomach down there below ground. Electric lights are often impractical or dangerous. An ingenious method of illumination with mirrors has been evolved. One man above a manhole catches the sun's reflection in his mirror and shines it below where it is picked up by another man and reflected along the pipe. It can be re-reflected as many times as are required to turn corners, providing light for hundreds of feet.

There are extreme hazards in work of this kind, but they have been greatly reduced by modern technology. Gas is the biggest danger, but it is controlled now by masks or portable ventilating machines.

Stoppages of other utilities, even of food, water, heat, or transportation, could not possibly do the damage to a modern city that would be done by sewerage failure. Today the normal possibilities of failure are enhanced by the possibility of sabotage or attack. However, there is little chance for sabotage of a metropolitan disposal system. Engineers and counter-espionage are prepared to thwart it.

If someone should interrupt disposal flow, we are still in a position to move swiftly to repair the damage. First step would be to neutralize the effects of any toxic sewage that leaked from blocked or ruptured mains. For this job, trailers equipped with chlorinating plants to pour purifying chemicals on contaminated areas could be on the scene in a few minutes. Even while they were en route, crews would be making preparations to re-route the flow. A valve would turn here. A blast would go off there. Soon the underground river would be flowing again, perhaps through old pipes disused for years, perhaps through regular mains that could accept an emergency overload.

The Ears of the Fleet

(Continued from page 15)

special instruction no ordinary radio operator could begin to understand them. An advanced amateur would be dazed by the weird circuits, futuristic-looking antennas, and odd-shaped vacuum tubes. The navy needs men to operate these creations and this is your chance to get in on the ground floor. Instruction starts at the beginning, so you don't even need to be able to handle a key to join.

You have a good start if you are an amateur operator. Most important, though, are high school mathematics and physics. English is important, and good spelling. If you know touch typing it will save time. Every operator pounds a typewriter.

The first course lasts 16 weeks, during which the students learn to take 23 words of code a minute on the typewriter and to maintain and repair the delicate apparatus, and to rerig sets under battle conditions, in absolute darkness if necessary.

Advanced instruction includes studies of acoustics. Sound plays an important part in some of the newest detection apparatus. Graduates may help design a giant antenna, operate a half-million-watt transmitter, or put together delicate ultra-high-frequency apparatus.

Graduates of the radio schools see plenty of action. Some are assigned to flying boats on reconnaissance patrols and bombing flights. Others go into submarines where, aside from communication, they have charge of detection apparatus that helps in locating targets. On battleships, cruisers, destroyers, and other surface craft the radiomen are assigned various duties. They may operate radio facsimile machines by which maps and other drawn information are transmitted. They may use a walkie-talkie during a landing operation, then set up portable long-range apparatus.

And radiomen don't stand by helplessly when their work is done. A navy tradition is to make each man competent in many jobs. An operator learns to signal by searchlight, flag and semaphore, to handle guns, and to help his mates in time of need.

It was a radioman at Pearl Harbor who jerked a machine gun from a burning plane and shot down a Jap plane. On land, at sea, and in the air, the navy's radiomen are fighting America's battle.



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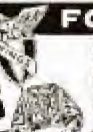
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Heavyweight Sluggers of the Sea

(Continued from page 61)

and because of the increasing importance of bombing planes, the five super-battleships of the Montana class may be converted into aircraft carriers. This does not mean America has abandoned the battleship. The carrier is essential to a balanced fleet, but it is a fighter with a glass jaw and must be backed up with a long, gray line of battleships.

It is a curious thing, but the American fleet until the present war has never met an enemy fleet in full-scale battle on the high seas. Yet no navy went into this war better prepared. Years of study, constant maneuvers, plus extensive gunnery practice have given the American navy the "know how" to win.

Ships of the fleet usually steam in column. Sometimes battleships proceed in single file with about 500 yards between ships, and at other times they form staggered columns with every other ship about 250 yards out of line. Both formations are designed to give maximum security and to allow the ships to swing into battle positions in the shortest possible time.

The fleet battle formation is arranged with a front line of destroyers, a secondary line of heavy cruisers, a third line of light cruisers, and a fourth line of destroyers—all screening the final line of battleships. Submarines prowl ahead of and behind the entire formation and try to intersect the enemy's flank.

The classic maneuver which brought the Japanese victory in the Russo-Japanese war and the British victory at Jutland is called "crossing the T." Using superior speed or more skillful maneuvering, the commander may bring his line of ships at right angles to the enemy. By pouring his fire on the leading enemy ships, he sinks them and disrupts the formation.

The American navy, because of the slower speed of many of its battleships, has developed an answer to "crossing the T." Light cruisers and destroyers steam ahead to counter-attack at the head of the enemy's line—thus forcing it to turn away. Then our battleships concentrate their fire on the enemy's rear ships.

If nothing else, this war will quiet the discussions of arm-chair admirals as to whether air power is superior to battleship

strength. Many navy men know that the question is not "bombers vs. battleships" but "bombers and battleships." There has never been any talk of the airplane replacing the tank in land warfare. And it is just as futile to say that the airplane will replace the battleship in sea warfare. Both aircraft and hard-hitting sea power are necessary to a well-balanced fleet.

That aircraft are necessary to the protection of battleships was proved beyond a doubt by the sinking of the British battleships *Repulse* and *Prince of Wales*. On the other hand, the *Illustrious*, an aircraft carrier and much more vulnerable, was bombed by more than 100 German planes in the Mediterranean and survived.

Three types of planes can inflict damage on battleships: (1) high-altitude bombers, (2) dive bombers, and (3) torpedo planes. High-altitude bombers are least effective because antiaircraft fire keeps them so high that accuracy is lost. The dive bomber is more formidable because it swoops down, lays its deadly eggs and gets away in a hurry. However, formations of planes must be used if this type of bombing is to be effective against battleships.

The torpedo plane is by far the most deadly enemy of the battleship. The British used it with telling effect against the Italian fleet at Taranto and against the French fleet at Oran. The Japanese used it to cripple the American fleet at Pearl Harbor and bagged the *Repulse* and the *Prince of Wales* in the China sea.

The lessons learned in this war are to be summed up as follows:

1. Battleships and naval fleets have not been rendered obsolete by aircraft.

2. No fleet, however, is safe from air attack unless it has air support equal to that of the enemy. This requires that battleships be accompanied by aircraft carriers.

3. No fleet is able to operate within 500 miles of enemy-held shoreline where there are superior numbers of land-based planes.

4. Units of a fleet must not be immobilized in a harbor for any length of time unless adequately protected by fighter planes, antiaircraft guns, barrage balloons and alert reconnaissance. (This is the mistake we made at Pearl Harbor.)

5. As a result of new weapons, the power of modern gunfire and the speeds involved, the tempo of naval engagements will be

(Continued to page 169)



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Aluminum Goes to War

(Continued from page 77)

the past. The elimination of this problem by the use of aluminum-bodied hopper cars, or steel hopper cars with aluminum facings, may well be considered.

The sinking of hundreds of merchant ships during the past three years means there is bound to be great activity in marine construction after the war. Aluminum has been a desirable metal for marine construction for a long time, because by its use the weight of a ship can be redistributed so that the ship will function as a more efficient unit. It will either be lightened to such an extent that smaller engines will be able to propel it at a given speed, thus saving fuel costs, or the same type of engine can propel the lighter boat faster.

Aluminum has been used in the textile field for some time, but its applications there can be widely increased. This is one of the most fertile fields for aluminum in the immediate future, particularly since rayon and nylon are enjoying ever-increasing popularity. Aluminum is widely used in the manufacture of these textiles.

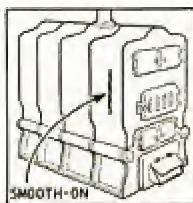
The art of brazing aluminum has been developed to a commercial degree within the past year or so. Activities in aluminum brazing had to be curtailed because of the war effort, but this method of joining aluminum will be resumed when circumstances permit.

The aluminum beer barrel got under way slowly at first, but it was found to be so excellent a package for beer that brewers began to buy it in large quantities. A typical half barrel of aluminum weighs only 18 pounds, while a wooden barrel of the same dimension weighs 65 pounds. The aluminum barrel does not have to be pitched, since aluminum does not affect

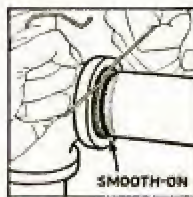
(Continued to page 170)

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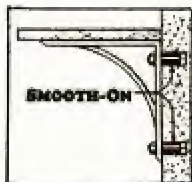
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Just to show you that the aluminum folks will not miss any bets in the world to come, one commodity might be cited which was ready for marketing when war priorities put a stop to it. That is the aluminum plate used by artists for making etchings and dry points. Copper had been the traditional medium for more than 400 years, but copper had certain disadvantages which have been overcome by a special aluminum plate. In the case of copper, an artist could only make about 75 good prints from an etched plate before the plate would begin to break down. He could only make about 15 good prints from a dry point. In aluminum, an edition of 250 prints is generally possible, and in many cases far more. This holds for both etchings and dry points on aluminum. The metal, furthermore, is light in color and easy on the eyes.

From these indications it seems that aluminum has a bright future as well as a busy present. Production is being stepped up so fast that President Roosevelt's request for 185,000 planes in 1942 and 1943 will be met easily, and there still will be aluminum left for the searchlight housings, the pontons, the trestles, the outboard motors and the thousand and one other things that are needed by this army and navy of ours to lick the spots off the dictators.

"Sleeping on Air" Is Predicted With Cellophane Bubbles

Chains of Cellophane air bubbles compose a buoyant material which can take the place of imported kapok or sponge rubber to relieve the wartime shortage. Called Bubblfil, the new product developed by E. I. du Pont de Nemours & Co., can be used in lifesaving jackets, in the air compartments of life rafts, in airplanes or tanks for padding, or as a "filler" for any other article requiring a resilient product. The material can be used in mattresses, making "sleeping on air" a reality. The cellulose bubbles cannot be broken by squeezing and they have withstood temperatures ranging from 28 degrees below zero to 200 degrees Fahrenheit.

To learn where to buy commercial products described in these pages, see the index.

Wilmington
POPULAR MECHANICS
Del

Recovering Riches From Smoke

(Continued from page 69)

The record of what these machines are doing is as long as it is amazing. Every day at one plant, Cottrell precipitators are recovering 55 tons of smelter dust, 20 percent of which is copper. At a silver refinery three tons of antimony dust are taken from the stacks every 24 hours. Ten tons of arsenic is the daily recovery at another plant, and 220 tons of cement dust a day is routine at a cement mill. Counting all cement mill installations, many thousands of tons of cement a day are being saved this way.

In another case, 120 tons of fly ash and cinders are being taken from the discharge chimneys of a boiler plant every day. In one such case the collected fly ash is used as a filler for concrete, and plant buildings have been constructed out of blocks composed of fly ash. In an oil refinery 5,500 pounds of sulphuric acid are trapped in the chimneys every day. In the production of manganese, aluminum, molybdenum, magnesium and tungsten, dust collectors and precipitators have increased the amounts being obtained.

Why can't the principle of electrostatic dust collection be applied to air cleaning? That is another job that it is doing, in department stores, hospitals, lens grinding plants and in other places where the air should be dust-free. One department store is saving \$4,000 a year in painting bills because dust and grime in the air are now collected by a precipitator. Electrostatic air cleaning as part of an airconditioning system is 90 percent efficient in removing all suspended matter from the air as against 10 to 20 percent efficiency of mechanical air cleaners.

Research engineers are now investigating another possible field. Many ores containing useful minerals are so complex that ordinary extraction methods are impractical. The engineers think if such ores can be subjected to high heats that volatilize the minerals, the minerals may then be collected by electrical precipitation. There are many problems involved but when and if these are overcome the result will multiply our natural mineral resources.

Look in the index to find where to buy articles described in this magazine. Say You Saw It in Popular Mechanics.

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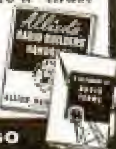
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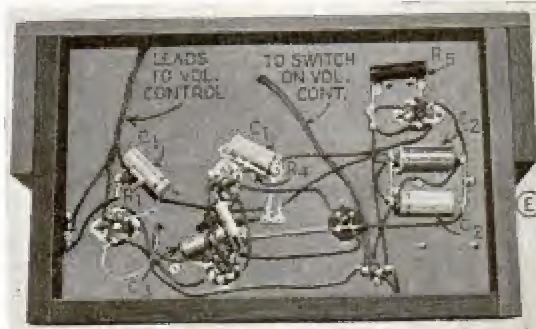
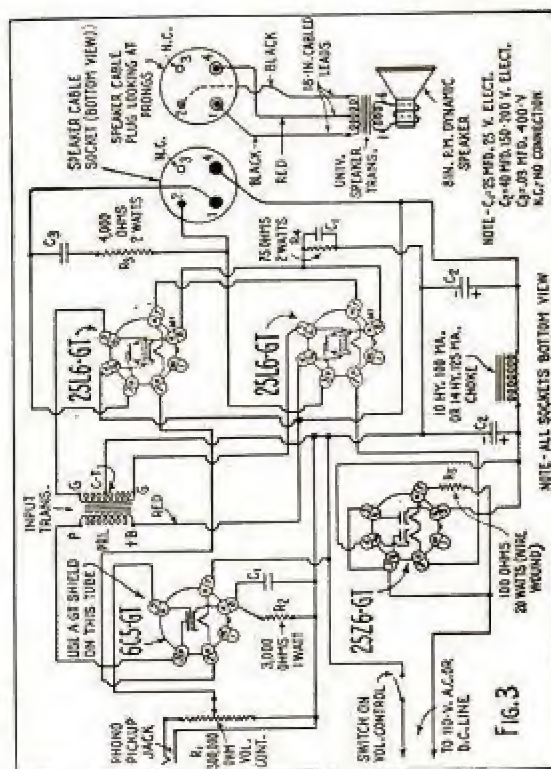
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A.C.-D.C. Four-Watt Phono Amplifier

(Continued from page 157)

from the record player (preferably one of the modern crystal pickup type) and start it running with a record on the turntable. Assuming that no errors have been made



in wiring the amplifier, it should reproduce the record. If it does not, snap off the switch and recheck your wiring.

Mounting the speaker on the baffle seemed to offer the greatest problem in the frame construction as the hole must be well centered, neatly cut and backed with grill cloth. Studio board or other 1/2-in. sound absorbing material is too thick for mounting the volume control in the usual

(Continued to page 174)

POPULAR MECHANICS



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manner, therefore a metal mounting strip, held with machine screws and washers, is employed as shown in sketch at upper left in Fig. 2, and front view photo B. A detailed list of materials is available from Popular Mechanics radio department without charge. Like all a.c.-d.c. units this one generates a little heat, therefore it is a good idea to provide the two vent holes in the baseboard directly below the R_3 resistor. If hum is at all noticeable try reversing the power plug in the wall socket. The blue-print number for this article is R-310.

Safety Code Oscillator

(Continued from page 158)

stituted for the mica types specified, and the 10 mfd. electrolytic condensers may be any value up to 20 mfd. or more. The .01 mfd. condenser and the 200-ohm resistor are used to eliminate key clicks.

One half of an ordinary 1/2-in. or 3/4-in. breadboard is used as a base for mounting the various parts as shown in the simplified diagram Fig. 2. Any wafer-type octal socket may be mounted on bushings as indicated in the inset sketch. The 10,000-ohm filtering resistor R_3 should not exceed 15,000 ohms. The line-cord resistor however, must be the value specified in order to supply the tube with the proper voltage, although a variation of 10 percent would work. Observe the polarity of the electrolytic condensers and connect them just as shown. The black lead in the line cord is not used, and should be covered with tape to insulate the bare end.

After completing the wiring, insert the tube and connect the headphones to the phone clips. Any type of headphone may be used. Touch one of the inside clips that are connected together; if line noise is heard, reverse the line plug in the wall outlet. Connect and depress the key; a pure signal should be heard. If it is not, reverse the connections to either the primary or secondary of the transformer. This oscillator will follow the fastest keying without a break. The code chart can be clipped and mounted near the key clips under a small piece of celluloid if desired. A companion article on easy ways of learning code, and describing a simple code receiver, that employs the same tube, will follow in an early issue, so save the other half of your breadboard.



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No shop is complete without a small arbor press. Pressing and squeezing operations can be done better and faster on a KRW Arbor Press. Stop using vise and sledge hammer methods—they generally deliver spoiled work in the end. KRW Factory-To-You Prices give you greater value for your money. Order today.

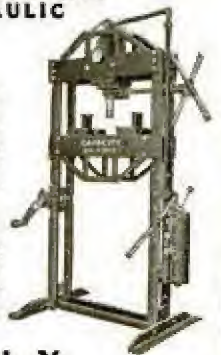
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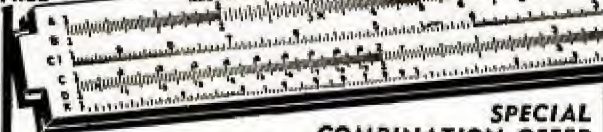
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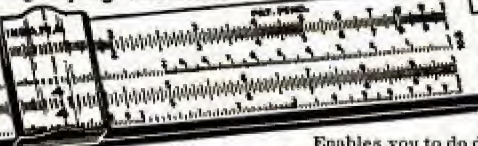
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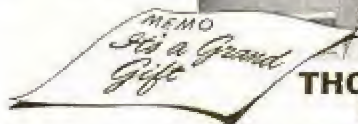
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Shortcuts to Victory

(Continued from page 4)

labor-management committees have been formed in between 800 and 1,000 war plants for the purposes of building morale and collecting ideas for increasing production. In the first 500 suggestions submitted at Douglas Aircraft, there were enough good ideas to bring about a saving of 2,000 man-hours per day, enough to build seven large bombing planes in a year. The Continental Roll and Steel Foundry increased production 20 percent after adopting 200 suggestions from employees and the Independent Pneumatic Tool Company has experienced a 21 percent increase, with production ideas coming in at the rate of 100 per week.

In plants where labor-management committees have been set up, the War Production Board has instituted a system of merit awards, corresponding to military decorations, for employees who devise means of increasing or improving war production. These awards are in addition to cash rewards and honor buttons and medals bestowed by the companies.

The first decoration for the production soldier is the "award of individual production merit," which plant committees are authorized to grant to any worker whose suggestions improve quality or production or conserve a critical material or in other tangible manner increase the effectiveness of production. The second award is the "certificate of individual production merit," for those making outstanding suggestions. This suggestion first must be adopted in the plant and the local committee must submit a complete report on its adoption. The suggestion is then studied and if found outstanding, the employee receives a certificate, signed by a representative of the War Production Board.

The highest type of award is the "citation of individual production merit" for the maker of a suggestion that will have an outstanding effect upon the entire war effort. This award consists of the citation certificate and a distinctive emblem.

And so the battle rages on the production front, with millions of workers striving to hasten the day of victory by providing their own answers to each individual's problem, which in brief is this: "How can I do my job faster and better, and thus help defeat my country's enemies?"

Drafting Our Forests

(Continued from page 13)

Cellulose and lignin are what wood is made of. The first plastic was celluloid. New plastics are made from lignin. Your telephone's instrument case, the "plastic" hardware performing a dozen duties in your house, probably started as sawdust.

This utilization of sawdust and wood waste is another example of conservation activity on the part of the timber industry. The other involves planned harvesting for continuous forest growth and tree planting projects. Hundreds of thousands of acres of forest land are being managed like vast "tree farms," where new crops are being harvested to constantly renew this abundant natural resource. Thus, ample wood is assured as a source for chemicals, substitute for priority materials, plastics and for other products.

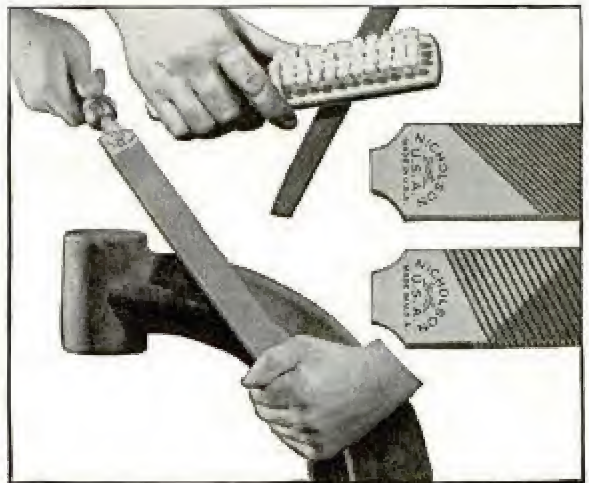
Plastics and the laminated woods fill hundreds of hardware uses. So does ordinary wood. One wood-frame window designed to overcome war shortages reduces the amount of metal in a unit from 20 pounds to 13 ounces. The pulleys are made from the wood that goes into bowling balls. The weatherstrip is of maple. Even hard maple hinges are on the market.

Rock maple serves as machine bearings. They actually outwear metal bearings in many cases, where speed, load, or high temperatures make graphited bronze or steel bearings unnecessary.

Shoes are made on hardwood lasts. Last manufacturers are also making hardwood shoe soles. One, for women's shoes, is made of two parts, hinged together with leather at the ball of the foot for flexibility. Leather plugs inserted in the sole stop clatter, increase traction. A leather heelpiece cushions impact. Incidentally, if your rubber heels are new they probably have wood cores.

Even bark has come to the rescue of war-rationed needs. A Boston manufacturer has brought out a mattress stuffed with sequoia felt. The sequoia is the redwood tree of California, and sequoia felt is made from its bark. This material has been used for insulation and for making clothing, especially rugged sports clothes. Other wood wools, like balsam, are used for cushioning and insulation in construction. Sci-

(Continued to page 178)



Proper Use... Proper Care... Proper Selection

Saves time—saves materials—saves files

• This is a war in which *conservation*, as well as *production*, is important. It applies to tools as well as to materials and products. The improper use, care and selection of files is particularly wasteful. No mechanic can consider himself at the peak of efficiency without a thorough mastery of the "art of filing."

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are serving a vital function on the U. S. Army's motor vehicles... reliable guides for any movements. War needs have stopped manufacture for civilian car owners, although some dealers still have a few in stock.

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entists have found a way to claim the cork in Douglas fir bark.

Wood turning has returned to its own with many refinements. Gifts of woodenware will be increasingly popular, particularly when they are the handicraft of the giver. Lack of metal for jewelry has made wood as popular a material of adornment as its polished grained beauty deserves.

Cradles traditionally have been made of wood. So, now, are perambulators, baby walkers, and scooters. With metal no longer available for re-enforced concrete burial vaults or for steel caskets, these are being built of white oak and cypress. These and other woods buried in the earth for a hundred years or more have been found as good as new. A recent hardware exhibition included lawn sprinklers, shoe trees, salt and pepper shakers, coat hangers (including the hooks), "smokodors"—those knee-high ash trays—and electric fan blades all made of wood.

Fan blades for cooling towers and exhaust installations in factories are made of resin-bonded laminated wood. These blades are four-and-one-half feet long and weigh only 25 pounds. Their surfaces, fashioned according to mathematical formula, assure ease in starting and reduce friction.

This review of products could continue almost indefinitely. Wood in new forms—chemically treated, cooked, molded under pressure—permits almost anything to be made of wood that can be made from any other material.

This versatility in use is matched by the abundance of supply. Here's an indication of how plentiful America's timber reserve is: Our forests are growing annually at a rate which would make it possible to build 2,665,000 new five-story homes each year from new growth alone. This is due to increasingly effective protection from fire, the natural growth and reproductive qualities of trees, and industry's increasing attention to forest management practices.

Home building is now deferred to the war effort, but much of the world will have to be rebuilt after the war. That means America will be called upon to supply the shattered nations of Europe. Here at home, also, there will be a giant job of providing new housing.

The outstanding construction develop-

ment in wood use caused by the war is its rediscovery by engineers and architects as material both for durable massive construction and demountable prefabricated buildings. Plywood is the backbone of prefabricated housing.

Two engineering developments have made possible all-wood construction of the most massive buildings—factories, warehouses, hangars, great halls. One development is the fabrication of great trusses and girders of laminated wood. This is plywood technique raised to gigantism. The other is development of small metal timber connectors which make it possible to join solid beams so that joints are as strong as the individual timbers. Spans of 200 feet are made possible.

One of the country's largest and oldest makers of iron and steel pipe, culverts, and other drainage products, has turned to wood. A wood pipe water system for a typical 35,000-man army cantonment can save 9,193,600 pounds of steel and almost a quarter of a million dollars.

Designers of modern furniture use wood in all its phases: solid wood, plywood, and plastics. One clock manufacturer who formerly cased his product in metal, uses compressed wood cellulose fiber—the same fiber from which paper is made. This replaces brass, aluminum, phosphor bronze, and steel formerly used in metal cases and aids the transportation problem by reducing shipping weight 47½ percent.

All of wood's old uses as well as the new, and many more still unborn in the research laboratories, can continue forever. The forest, unlike the minerals and coal and petroleum deposits, can be made inexhaustible under the type of management which the forest industries are furthering.

"Home" Chemist Can Make Dye With Sassafras and Ammonia

Natural dye from root bark of the sassafras tree is extracted with a simple and economical process discovered by Dr. Arthur C. Shead of the University of Oklahoma. Residue from the distillation of sassafras oil is put into a solution of ordinary household ammonia, the dye extracted by the ammonia's action and then precipitated with acid. Colors obtained from the dye are tan, darker shades of brown and a close resemblance to pearl gray.

JANUARY, 1943

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HOW TO GET THE MOST OUT OF YOUR LATHES

No. 3 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production

Keep Your Lathes Level

The leveling of a lathe can either perpetuate or destroy the best craftsmanship of the machine tool builder. A lathe that is not kept perfectly level cannot turn out the precision work for which it was built.

The lathe bed is comparable to a toolmaker's surface plate. Upon it rest the headstock, carriage and tailstock. Therefore, any twisting of the lathe bed will throw the headstock, tailstock and carriage out of alignment. This will cause the lathe to turn or bore a taper instead of taking a straight cut. It will also cause the alignment of the tailstock center point to shift as the tailstock is moved along the lathe bed, necessitating constant readjustment of the tailstock top set-over.

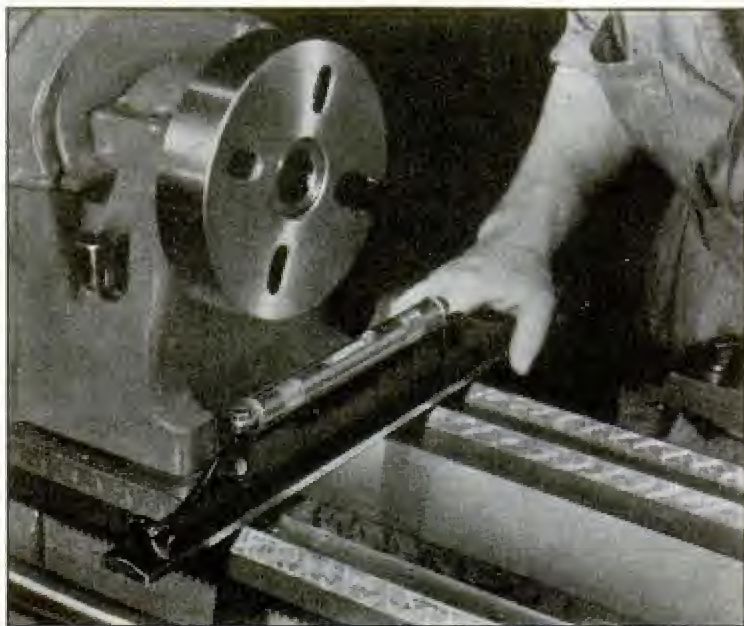
Check Leveling Frequently

The major cause of distortion in lathe beds is the settling of the floor supporting the lathe. This is most commonly encountered in buildings that do not have solid foundations or that have wooden floors or columns. There are numerous other conditions which can cause this, such as the shifting of loads on the floor, swelling of wood flooring, deterioration of wooden shims, and atmospheric changes. For these reasons, every lathe should be checked periodically to see that it is level.

How to Level a Lathe

The first requisite for accurate leveling is a precision level at least 12" long. One that is sufficiently sensitive to show a distinct movement of the bubble when a .003" shim is placed under one end of it. A carpenter's level, a combination square level, or an ordinary machinist's level cannot be used because they are not sufficiently sensitive.

The leveling of the lathe is tested



Every lathe should be checked periodically to see that it is level

by placing the level squarely across the lathe bed, immediately in front of the headstock, and also at the extreme right end of the bed. On lathes having long beds, tests should also be made at one or more intermediate positions. Be sure that the ways are wiped perfectly clean of all chips or dirt before using the level.

Metal shims should be used under the lathe at the points indicated by the level as being low. Some lathes are equipped with leveling screws making it unnecessary to use shims.

After all adjustments have been made, bolt the lathe securely to the floor and repeat the tests to make sure that tightening the leg bolts has not affected the leveling of the lathe.

Alignment Test

A simple alignment test can be used to check the leveling of a lathe. Place a bar of steel, one inch or

larger in diameter, in the chuck and machine two collars of equal diameter three or four inches apart. Then, take a very light finishing cut across both collars without changing the setting of the cutter bit. Measure both collars with a micrometer. If the collars are not the same diameter, it is an indication that the lathe is not level. Adjust the leveling until, when a cut is taken, both collars are turned the same diameter.

Write for Bulletin H3

Bulletin H3 giving more detailed information on the installation and leveling of lathes will be supplied on request. Also reprints of this and other* advertisements and bulletins in this series. State quantity.

*Ad. No. 1, "Keep Your Lathe Clean" Bulletin H1, "Keep Your Lathe Clean"

Ad. No. 2, "Oiling the Lathe" Bulletin H2, "Oiling the Lathe"



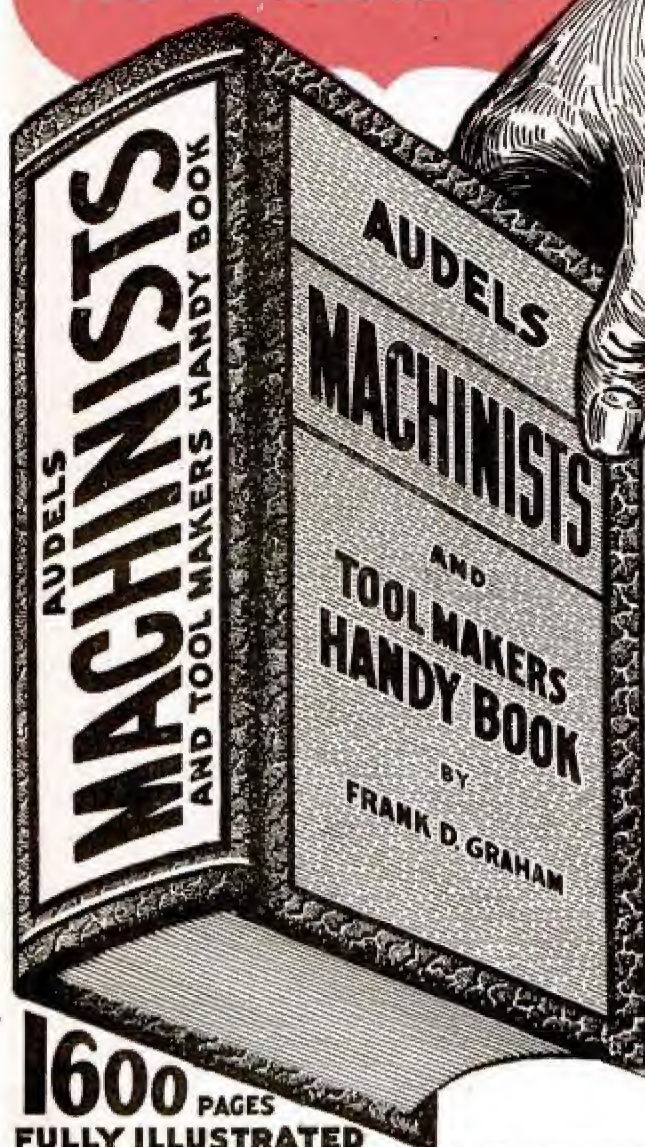
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And—Camel's the cigarette you find so regularly with the skilled artisans who "keep 'em flying"...like Charlotte Thon (*below*). "Camels suit me to a 'T,'" she says. And that's a language any smoker will understand (*see "T-Zone" below, right*).

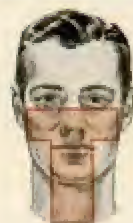


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